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EXPERIENCES WITH ORBITO-ETHMOIDAL OSTEOMATA HAVING INTRACRANIAL COMPLICATIONS

WITH THE REPORT OF FOUR CASES[1]

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AS ONE who was admitted to this body twenty years ago under the guise of being a general surgeon, I confessedly though unwittingly have fallen from grace. In consequence of this, my appreciation of the compliment the association has paid me is all the greater. In 1880 when that remarkable person Samuel D. Gross took steps to found this society, men of his large mold were not only able but were obliged to compass practically the whole of surgery. Since then the field has so widened as to encourage if not actually to force specialization upon us.

Even in those simpler days when this society was young, every surgeon must have been conscious of the fact that as he progressed there were certain things which interested him more than others, certain lines of work in which he preferred to engage and in which he accumulated experience and skill above the ordinary. Had this not been so, surgery would have remained stationary and we would be doing the same sort of things in the same sort of way as our predecessors. At the present day few of us can hope to make definite and permanent contributions to more than one small subject. As the surgical vista widens, the scope of one's general work shrinks, and consequently each of us in a fashion, whether by force of accident or by premeditation, comes to particularize and to pioneer in his work.

Nevertheless, there are not a few general surgeons who, quite unconscious of their own pioneering, look upon the convert to surgical specialization as a renegade from the guild. What are surgical specialists but those whose chief insignia is a headlight or a reflecting-mirror, wherewith to illuminate some orifice, mentionable or otherwise, within which they supposedly do their work? Specialization in such tasks might well enough be condoned were it not that the specialist, taking advantage of his orificial introduction to surgery, is too much inclined in the opinion of some to poach on adjacent territories quite out of his province. For should he yield to this temptation he will be certain to encounter problems which entice him, but which, from his insufficient training, he is unfitted to attack. There may be some grounds for this criticism, but no less deserving of criticism is the sort of "all or none" attitude, still sometimes assumed by the general surgeon who is overready to apply his scalpel to any organ or part of the body whatsoever.

There are, as I see the matter, two kinds of specialists: those who have had a general surgical training before they particularize in their work as most of us do sooner or later;

[1]Presidential address before the American Surgical Association, Richmond, Virginia, May 12, 1927.

and those who begin with specialization and subsequently squeeze their way from the sidelines into the arena of general surgery—an inconsiderate procedure which those who have started out with a general surgical training naturally decry.

But the difficulty with all this lies in the fact I have touched upon, that even the so-called general surgeon is prone, in course of time, to devote himself largely to a particular type of surgery in which he excels. In consequence of this he is likely to overtrain his assistants and pupils in that special field of work, and so, quite unconsciously no doubt, he lets loose on the community a new generation of specialists whether or not they happen to be so designated. The pupils of these men in turn tend to creep back into general surgery, sometimes even after their special field has become so well recognized as to secure representation in the Faculty and a place for their subject in the curriculum.

But it is no longer possible to define clearly the limits of one's surgical bailiwick. It is a question of self-determination and there can be no more permanency to the boundaries of a surgical specialty than to the boundaries of the Balkan States. It is impossible to stake out permanent claims on the shifting sands of changing custom. Even a simple invention or some novel device may encourage specialization. The eustachian catheter is said to have made otology possible just as the ophthalmoscope made a new order of ophthalmologist. The surgeon had to learn his work anew after Paré rediscovered and vulgarized the ligature. Who can tell what may be ahead of us? Perhaps electro-surgery, which may supplant the ligature by dehydration and coagulation as certainly as the ligature supplanted the cautery and boiling oil. Who of us knows what discovery may tomorrow entirely revolutionize our craft? We may be sure it will be opposed by those who "sit on the Right," as the principles of Lister were opposed.

It was with these thoughts in mind that I have chosen to address you today on a certain topic which distinctly overlaps the fields of three recognized surgical specialties: that of the oldest of them all, ophthalmology; that of the newest, neurosurgery; and that of another, rhinology. What is more, it is a subject which concerns a lesion that in its early stages could hardly have been diagnosed without operation before Roentgen's discovery which has so fundamentally affected our surgical diagnosis and procedures.

The lesions I shall speak about are the pedunculated osteomata of the ethmoid cells which secondarily come to involve the orbit; and I shall venture to propose a new method of exposing such of them at least as send projections into the cranial chamber and produce complications there. It is a subject whose literature naturally enough is largely confined to ophthalmological journals since the ophthalmologist for obvious reasons is likely to be primarily consulted; and if venturesome and prepared to undertake operations of considerable magnitude, he has been the one, as the literature makes clear, who heretofore has undertaken surgically to deal with the lesion.

Nevertheless, in the authoritative works on ophthalmology, the subject is dismissed with scant reference beyond a warning against the hazards of operating for other than the more common pedunculated osteomata arising in the frontal sinus, with which it is not my present purpose to deal. The operative treatment of the orbito-ethmoidal osteomata offers far more serious problems, as the four following case histories will make clear. The running comments, interjected in the case reports, will serve to show what tribulations I have suffered in the process of acquiring some idea of the primary site and nature of the lesion in question, and of the varied complications it may provoke.

CASE 1. Surg. No. 21385. *Orbito-ethmoidal osteoma clinically mistaken for a meningioma of the olfactory groove. Transfrontal osteoplastic exploration disclosing intradural projection of osteoma. Removal of tumor through roof of orbit with unavoidable opening of ethmoid cells. Cerebrospinal rhinorrhœa. Death from infection and meningitis.*

May 19, 1924. Admission of Thomas T., aged 23, referred by Dr. L. W. Tindolph of Olean, New York, with the complaint of headache, unilateral exophthalmos, photophobia, and loss of vision.

Anamnesis. For a period of about 6 months, there had been a slow but steady increase in the

symptoms complained of. In addition there had been occasional periods of slight diplopia, and the patient had observed that the eyeball had become harder as well as more prominent. A few weeks after the onset of symptoms, he had been operated upon for a presumed ethmoiditis with negative findings. Aside from this he had received no treatment. He had been able to continue at work until shortly before his hospital admission.

His previous history had no apparent bearing on the condition except for the fact that he had received 5 years before a glancing blow over the right eye. This had left a small scar on the brow. He had once had his tonsils and adenoids removed; and a mastoid operation had been performed some time before the onset of his present trouble. There was a chronic left otitis media with perforation.

Physical examination. This revealed little more than has been told. There was on the right side an appreciable but not obtrusive exophthalmos (Fig. 1) with slightly dilated pupil. The globe was firm and unyielding to pressure. The fundus showed slight primary optic atrophy. A central scotoma was demonstrable, vision being reduced to 4/200. There was in addition a relative right-sided anosmia. The ethmoidal mucous membranes on the right side appeared injected, but a careful examination after shrinkage with adrenalin revealed no anomalies. The lateral stereoscopic X-ray films disclosed (Fig. 2) a poorly defined area of increased density in the posterior portion of the right orbit, the orbital plate appearing intact. The postero-anterior films (Fig. 3) showed clearly that this shadow extended into the region of the right ethmoidal region underlying the olfactory groove. The right frontal sinus was undeveloped.

Diagnosis. The roentgenologist ventured a diagnosis of sarcoma. Clinically an olfactory-groove meningioma with secondary thickening of the subjacent bone was favored. An orbito-ethmoidal osteoma was not suspected.

May 28, 1924. Exploratory operation. The usual right frontal osteoplastic flap was reflected with the lower incision in line of the brow. The dura was elevated from the roof of the orbit back to its firm line of attachment along the sphenoidal ridge. There was no evidence of a meningioma but projecting through the dura from over the posterior ethmoidal region, a small, hard, bony nodule was encountered. When the attached ring of dura had been freed from the neck of this nodule (*cf.* Fig. 4), there was an escape of cerebrospinal fluid. Realizing that the bulk of the tumor must lie within the orbit, the roof was chipped away, exposing Tenon's capsule through which the main tumor mass could then be palpated. The capsule was incised and when the orbital tissues had been brushed away to the right the upper surface of a dense, bony tumor of irregular shape and cartilaginous smoothness was exposed.

The small nodule which projected into the cranial chamber was then separately broken away by

Fig. 1. Case 1. Patient before operation, showing the slight exophthalmos of the right eye.

rongeurs from the ethmoidal region. In doing so an adjacent mucocele was opened, and a mass of tenacious gluey and supposedly sterile mucus escaped. No cultures were taken. The large nodule was then easily rocked free and lifted out of the orbit (Fig. 5).

Before closing the wound a futile attempt was made to occlude the opened ethmoidal cells by coaxing the fatty orbital tissues to lie against them. After complete hæmostasis, the flap was replaced and the scalp sutured in the usual fashion without a drain.

First comment. Here was a case in which a lesion, with which I was ill prepared to deal, was unexpectedly encountered. The preoperative diagnosis of a meningioma of the olfactory groove (dural endothelioma) had been based on the combination of a unilateral anosmia and the bony shadow supposedly involving the inner orbital wall. Meningiomata arising from this situation are fairly common lesions. I confess, however, that it is the outer side of the orbit and wing of the sphenoid that is usually involved in the para-orbital meningiomata associated with cranial hyperostoses,[1] whereas here the

[1] There have been 12 examples of this with unilateral exophthalmos in our tumor series. *Cf.* "The cranial hyperostoses produced by meningeal endotheliomas." Arch. Neurol. & Psychiat., 1922, viii, 139–152.

Fig. 2. Case 1. One of the right lateral stereoscopic films showing indistinct shadow between arrows in region of right orbital roof mistaken for osteo-sarcoma.

process was confined to the inner side of the orbit in the region of the ethmoid cells which are rarely invaded by meningiomas. Our suspicions consequently should have been aroused.

Moreover at this time I did not fully appreciate that the so-called orbital osteomata are isolated and detachable tumors which inevitably originate on the ethmoidal side of the inner orbital wall (lamina papyracea) and which, in the process of their growth, push the latter ahead of them. Hence if the orbital contents are really to fall back into place, the thin scale of the displaced lamina must be removed after the tumor itself has been dislodged. Consequently, I withdrew from this particular operation, leaving not only a direct communication between the open arachnoid spaces and the unroofed ethmoid cells but also a pocket in the back of the orbit to become filled with wound secretions. A postoperative disaster was thereby courted. To continue with the story:

Postoperative course. For the first 24 hours there was considerable discharge of bloody cerebrospinal fluid from the nose. It then ceased. The exophthalmos which had been present before the operation was slightly increased after the operation and the globe was pulsating, due, as was supposed, to the transmission of the cerebral pulsation to the unroofed orbital contents. The wound healed well and aside from some occasional complaint of headache there were no untoward symptoms for the first week and recovery was looked for.

On the evening of June 5th, 8 days after the operation, he became drowsy, vomited, had a chill and the temperature rose in a few hours to 105 degrees. The wound was re-opened and a large extradural and retro-orbital abscess was disclosed. A meningitis was already under way and from this he succumbed in about 24 hours from the first onset of these sudden and alarming symptoms.

A postmortem examination revealed an extensive fibrinoplastic exudate over most of the right hemisphere. Cultures showed a poorly-growing gram-positive coccus in chains, possibly a streptococcus.

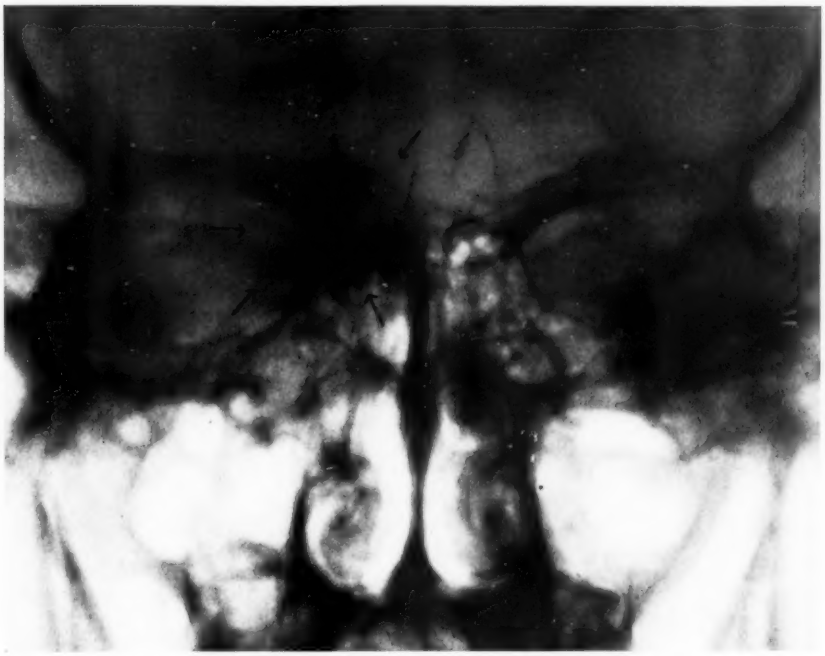


Fig. 3. Case 1. Postero-anterior view showing how indistinct may be the shadow (indicated by arrows) of a large orbito-ethmoidal osteoma.

Second comment. This was a very disheartening finale to what had promised to be a most favorable operation. Whether the mucocele had been the source of the infection or whether the field of operation had been secondarily infected from the nose is now difficult to tell. It certainly would have been wise to have closed the opening in the dura in some way, but it took further experience to make clear the necessity or possibility of doing so. To have left for a few days a gutta-percha drain in the lower angle of the wound leading from the opened ethmoidal cells would probably have served the same purpose, but the neuro-surgeon's tendency is to close all craniotomy wounds securely and to avoid drainage if possible.

This lamentable experience was sufficiently disheartening to stay my hand in the next patient with an orbital osteoma that came under observation. My conservatism, however, led to an equally disastrous outcome. As a matter of fact we were not yet sufficiently familiar with these unusual lesions to know what a variety of complications they might provoke. The history follows:

CASE 2. Surg. No. 22445. *Orbito-ethmoidal osteoma with intracranial complications. Convulsions and recurrent orbital infections. Previous lateral craniotomy with drainage of infected(?) aerocele. Attempted exposure of tumor blocked by infected frontal sinus. Subsequent surgical procrastination. Nasal rhinorrhœa with ventricular pneumatocele. Death from meningitis, 4 years after onset of symptoms.*

October 14, 1924. Admission of John W. C., aged 22, referred by Dr. H. H. Fox of Miami, Florida, with the complaint of convulsions.

Anamnesis. He had previously enjoyed perfect health. Aside from a trauma of the mid-frontal region received some 10 years previously, which had left a small scar, his antecedent history had no apparent bearing on his present trouble. In *September of 1920* suddenly and without apparent cause the right eye and side of the face became painful, swollen, and œdematous. There was some protrusion of the globe with diplopia. The ethmoid

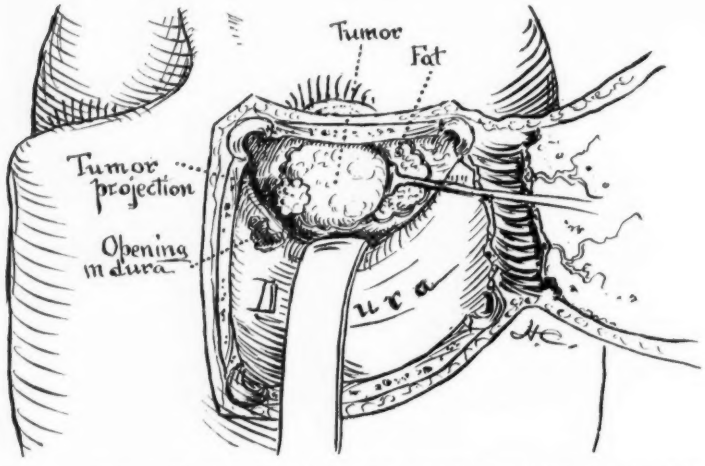


Fig. 4. Case 1. Sketch made subsequent to operation roughly to show the field with the exposed tumor and nodule which had penetrated the dura. (Reduced 1/3.)

cells were promptly opened under novocain without finding the source of the trouble, which soon spontaneously subsided. There were no further symptoms for nearly 2 years, when suddenly in *April, 1922*, without preliminary aura he had a general convulsion. Subsequent seizures of the same kind occurred in August, September, and December of the same year.

In *April, 1923*, there was an exact recurrence of the primary episode, namely a painful and œdematous swelling of the eye with fever. This must have been accompanied by intracranial symptoms which caused apprehension, for at this time an emergency trephine opening was made by a surgeon in Galveston, Texas, in the right temporofrontal region. The frontal lobe was punctured and according to the report "an accumulation of air and cloudy serum was encountered and evacuated." Digital examination of the cavity disclosed "a bony growth as big as the end of the thumb inside the skull near the mid-line above the nose." It was the surgeon's belief that the lesion was in some way consequent upon a former infection of the ethmoid cells. The temporal wound was drained and finally healed.

He made a fair recovery from this operation and remained well for 3 months. He then had three convulsions in succession and not long after there was a repetition of the painful swelling about the orbit which has been described. This attack was more severe than the preceding ones and was associated with bad headaches and vomiting. An X-ray was finally taken on *October 2, 1923*, which disclosed a bony tumor projecting into the cranial chamber in the region of the lamina cribrosa. From this third febrile attack he recovered, and aside from periodical headaches there were no further symptoms till *March, 1924*, when he again had a succession of generalized convulsions. From that time the convulsions became increasingly frequent and by September they were of weekly occurrence. Because of these attacks he was referred to the Brigham Hospital.

Physical examination. This showed a well set-up, healthy-appearing young man with the above-mentioned operative scar in the right temporal region (Fig. 6), and a small scar in the mid-frontal region ascribed to the trauma received when he was 12 years of age. From a neurological standpoint the examination disclosed merely a questionable diminution of olfactory perception in the right nostril, a slight inequality of the pupils, the left being larger than the right, and a slight exophthalmos with downward displacement of the right eyeball. The fundi oculi were normal, visual acuity was unimpaired, and the fields were normal. Intranasal examination revealed no abnormalities.

First comment. Here, then, was a young man with a story of three attacks of acute swelling of the orbital tissues. After one of these episodes, an operation on the ethmoid cells gave negative findings; after another, a craniotomy disclosed a frontal abscess (?) containing air and fluid; after the third the swelling spontaneously subsided. In addition there had been a series of general convulsions over a period of 2 years.

The physical examination was practically negative and without the X-ray a diagnosis

would hardly have been possible. This corroborated the observation of the previous year, namely in disclosing (Figs. 7 and 8) "in the region of the right olfactory groove extending laterally over the roof of the orbit and apparently down into the orbit a dense bony mass with smooth and distinct outlines suggesting an osteoma." The sinuses showed no involvement.

Though I was distinctly gun-shy on account of the outcome of the operation in the preceding case, nevertheless an exploration was advised and undertaken. The account follows:

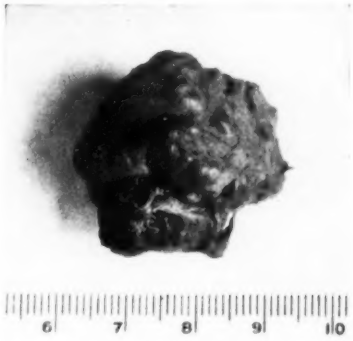


Fig. 5. Case 1. Showing the upper surface of the osteoma as removed (nat. size).

October 28, 1924. Right frontal osteoplastic craniotomy. Accidental opening of infected frontal sinus. Radical operation abandoned. Drainage of sinus.

In this procedure the usual frontal osteoplastic flap was made, with the lower leg of the incision in the line of the brow. Ordinarily one has no great hesitation in these operations in cutting with the gigli saw across the frontal sinus when it shows, as in the case of this patient, no roentgenological evidence of infection. However, there was no especial reason of having the flap particularly low, and it was my intent to avoid the well developed sinus. Nevertheless its tip was opened, fortunately without injuring the mucous membrane. The dura was elevated from the orbit far enough to come down upon the dense meningeal attachment encircling the neck of the readily palpable osteoma which projected through the membrane into the cranial chamber.

At this juncture, the mucous membrane over the small opening into the frontal sinus suddenly ruptured and purulent-looking material escaped into the field. Though immediate smears showed no organisms, fearing a possible infection from this source, the major operation was abandoned. The anterior wall of the frontal sinus was then widely opened and the cavity found to be filled with infected polypi. These were cleaned out together with the mucous membrane, and the minute frontonasal canal was dilated. The osteoplastic flap was then replaced, the wound being closed in the usual two layers, a small gutta-percha drain having been left leading from the opened frontal sinus.

The major wound healed by the usual exact primary union; the drain was removed on the third day and the small drainage canal promptly healed (Fig. 9). He was discharged on *November 10th* with the understanding that he would return in 2 weeks for the resumption of the operation. It was hoped that by then the conditions of the frontal sinus would have become quiescent.

Second comment. As I project myself again into the memories of this patient's case, I am conscious of having been oversensitized by the outcome of the preceding experience and to have shown a surgical white feather. The cultures from the supposedly infected sinus proved to be sterile, there was no discharge from the point of drainage which promptly closed, and, as subsequent events made it clear, this would have been the time to have re-elevated the flap and to have completed the operation. I confessedly had not as yet the vaguest conception that these tumors might of themselves set up serious intracranial complications irrespective of any surgical intervention. Hind-sight is always better than foresight, and the surgical problem was a much simpler one than we then conceived it to be. To continue with the story:

After his return home on *November 10, 1924*, he remained so free from symptoms that he felt disinclined to have anything more done. He had gone back to work, become engaged to be married, and it was not until *January of 1925* that he re-entered the hospital for observation. There had been no more convulsions and he seemed to be in perfect condition.

However, a most unexpected thing happened a day or two after his admission. He complained one day of having a slight cold with watery discharge from the nose when he stooped over. Inquiry elicited the fact that he had been intermittently subject to this sort of thing for the past 2 years or more. It had not occurred to him to mention it nor had the possibility of a rhinorrhœa been inquired into on his previous admission. He also stated that after these periods of "running nose" he was apt to feel a swishing sound on moving his head, and sometimes heard a tinkling noise.[1] He lowered

[1] I am not sure whether this was always consequent upon a sneeze, but it may have been. In one of his subsequent letters he spoke of the sequence of first sneezing, then of feeling the air rush into his head and subsequently of getting the tinkling sound, which would usually be gone in 24 hours.

and then raised his head and said, "I can hear it now." The patient's subjective observation of this extraordinary phenomenon was easily corroborated. The following note is quoted from his case record:

"On lowering his head he hears (and one can hear with the stethoscope placed anywhere over the head) from three to four sharp metallic sounds like drops of mercury striking the bottom of a tin pan; on raising and throwing back his head, he hears these three or four sounds repeated. The impression is gained that there must be, somewhere in the skull, an hourglass-shaped pocket containing fluid with bubbles of air which pass from one cavity to the other through a narrow neck. The patient locates the sound as being *within* the bony tumor with whose situation he is familiar from seeing the roentgenograms."

A series of X-ray films were immediately taken which showed that the bubble of air was in the cerebral ventricle and shifted from the frontal to the occipital ventricular horn on change of position.

Final comment and end-result. This most disconcerting happening completely unsettled my already wavering judgment about the advisability of operating. As matters stood, the risk of an ultimate infection with meningitis could not be minimized. Nor was there any assurance that an operation could be undertaken without greatly increasing this risk. I had known of patients with a cerebrospinal rhinorrhœa which had persisted for years without serious consequences. I had never known of the combination of an orbital osteoma with a cerebrospinal rhinorrhœa, and at the time looked upon the likelihood of curing either condition as improbable.

Under the circumstances and since the young man regarded himself as well and was about to be married, there seemed to be no justification in urging immediate intervention. He consequently was allowed to return home with the understanding that he would report in the event of any further trouble. Three months later, after spending an evening at the theater apparently in perfect health, he awakened at 5:00 a.m. with a headache. This was followed by vomiting. At 10:30 he had a convulsion and a few hours later he died with a temperature of 106 degrees.

The experience with these two cases was enough to make me feel that the problem was certainly baffling if not surgically hopeless. They were both young men in the prime of life and it is difficult to say whether I felt more disconsolate over, and more responsible for, the death I had provoked by an operation, or for that which followed my surgical procrastination. That we still had much to learn regarding the underlying pathology of the lesions in question and their possible intracranial complications, will be made evident by the story of the third case.

CASE 3. Surg. No. 24926. *Huge intracranial pneumatocele of unexplained origin exposed and emptied at operation. Recurrence of pneumatocele. Second operation, revealing a minute pneumatic sinus alongside an orbito-ethmoidal osteoma. Closure by fascial stamp. Recovery.*

October 6, 1925. Admission of Mr. H., 41 years of age, referred by Dr. R. J. Carpenter of North Adams, Massachusetts, for advice concerning certain obscure cerebral symptoms and peculiar X-ray findings.

Anamnesis. He had always been vigorous and healthy. The only noteworthy incident was an automobile accident 5 years before admission in which he sustained a laceration of the frontal scalp. A cranial injury was not suspected; there were no disturbing sequelæ; and the patient at least had no suspicion that this injury was in any way related to the symptoms which first put in their appearance 4 years or so later.

About a year before his admission he began having periodical left-sided headaches. Ere long he observed increasing awkwardness in the use of his right hand in such ordinarily simple acts as brushing his teeth or dealing cards. At the same time he began to experience considerable hesitancy in speech, loss of memory, and difficulty in calculating. These things were ascribed to nervousness from worry and he was sent abroad for 5 months. He returned improved but the symptoms reappeared as soon as he resumed his business tasks.

Physical examination. This revealed nothing more than a possible slowness of thought and of expression which to a stranger would not have been noticeable. His handwriting was quite legible, but according to his statement he wrote only with concentration and undue effort. There was no evident loss of memory. He was alert and co-operative in every way. The subjective weakness in the right arm was not objectively demonstrable. The eyegrounds, fields of vision, reflexes, and all else were quite normal. But the cranial X-ray films disclosed an amazing and unfamiliar picture. Dr. Sosman's report on them is as follows:

"Left stereos of the skull (frontispiece) show a vault of average thickness with a long, sharply outlined, clear area running backward along the left frontal bone about 13 centimeters in length and 5 centimeters in width. This has the density of air. The

(adjacent cranial) bone is apparently involved as shown by serrations along the superior margin of this shadow. Elsewhere in the shadow, there are different degrees of density (Fig. 11), possibly due to varying thickness of the bone. Most of the films show (Fig. 11) a dense shadow in the region of the left frontal sinus, with no apparent connection between it and the large area of decreased density."

"*Interpretation.* The findings may be due to a large cholesteatoma similar to that previously observed in the clinic. The lesion in the frontal sinus may be an osteoma."

First comment. Here, then, was a man whose symptoms and complaints were purely subjective. The only objective evidence of trouble lay in the X-ray findings. These showed a small orbito-ethmoidal osteoma which apparently had no bearing upon the surprising intracerebral lesion which was revealed. This cyst, or whatever it might be, had the translucency of air but otherwise so closely suggested the X-ray appearance of a huge cholesteatoma which had been previously encountered[1] in the clinic, as to have been misleading. I personally favored an air cyst, but the significance of the small osteoma which was thought to lie in the frontal air-sinus was entirely disregarded and I had not the slightest idea that the problem before us had any bearing on the two cases which have already been described. There was no X-ray evidence of a fluid level in the cyst; shaking of the head caused no sensation of succussion; there had been no rhinorrhœa. An exploratory operation was advocated and its description follows:

November 12, 1925. Operation under novocain, disclosing huge subcortical pneumatocele. Replacement of air by fluid. Closure.

Uncertain of what the lesion might be, a large left frontal flap was outlined (Fig. 12). So soon as the primary cranial perforations disclosed normal dura my suspicions that we were not dealing with a diploetic cholesteatoma were confirmed. The flap consequently was turned down and the dura exposed. It was slightly tense and bulging but there was nothing to betray an underlying lesion. On incising and reflecting the membrane upward, the entire upper half of the widely exposed hemisphere was found to be occupied by a yellowish, comparatively non-vascular and bulging cortex. This area was sharply demarcated from the rest of the brain which was firm and normally vascularized. The appearances were precisely those of a gliomatous cyst of unusual size covered by an excessively thin layer of cortex and pia-arachnoid.

Fig. 6. Case 2. Patient before operation, showing slight downward displacement of right eye with narrow palpebral cleft. Note scar of previous operation in right temporal region.

The cyst was punctured; there was a puff of air, and its walls immediately collapsed leaving an excavation of astonishing size. The thin walls of the cyst were then lifted and the opening enlarged so as to allow inspection of the cavity. It contained no fluid whatsoever, and therefore had no communication with the ventricle. Its walls were perfectly smooth and composed of the naked white nervous-tissue without any covering membrane of any sort. Anteriorly the cavity ran down into a sort of funnel corresponding with the pear-shaped shadow of the X-ray. I then surmised for the first time that the cyst might possibly have some connection with the orbital osteoma. I, however, did not feel justified in pressing an investigation of this possibility for the operation had been sufficiently prolonged. Consequently, the cyst was refilled with Ringer's solution; the dura was re-sutured; the flap was replaced after as careful hæmostasis as possible, and the wound closed without drainage.

He made an excellent surgical recovery. Healing was perfect (Figs. 12 and 13). Postoperative X-rays taken on *November 16th*, *November 24th* and *December 1st* (Fig. 14) failed to show any re-accumula-

[1] The case has been reported. Cushing, H. A large epidermal cholesteatoma of the parieto-temporal region deforming the left hemisphere without cerebral symptoms. Surg., Gynec. & Obst., 1922, xxxiv, 557-566.

Fig. 7. Case 2. Showing on lateral view the site of the former temporal operation and the dark shadow of the osteoma (nat. size).

tion of air. Subjectively he was greatly improved and by the time of his discharge on *December 5th* he stated that his mental activity seemed more alert than it had been for at least 2 years.

Second comment with interval notes. Could it have been foreseen what was in store for us and had we felt certain of the bearing of the osteoma on the pneumatocele, an immediate attack on the bony lesion with the purpose of closing the communication would have been the proper course. However, I was not as yet convinced of their relationship. Certainly the pneumatocele, if it actually was one, which had been opened and drained by another surgeon in the preceding case, contained both air and fluid and the subsequent X-ray films had shown the presence of air in the ventricle. Here, on the contrary, was a perfectly dry pneumatocele and I could not understand how air could get from the nasal sinuses into the brain substance itself without at least crossing the meningeal spaces and setting up a rhinorrhœa. What is more, I was fearful of establishing a rhinorrhœa where none existed. But let us continue with the patient's history:

On *January 6, 1926*, a month after his discharge, he reported, stating that his symptoms had completely disappeared and that he felt like his old self. The X-rays, however, showed (Fig. 15) a partial refilling of the cyst with air and apparently a fluid level.

On *February 2* he returned again still feeling well. The X-rays showed (Fig. 16) a further increase in the amount of air, the cavity having a multilocular

Fig. 8. Case 2. Anteroposterior view showing the osteoma (nat. size). Note deflection of septum.

appearance. The air-pocket showed a funnel which unmistakably pointed in the direction of the small osteoma. No fluid level was demonstrated.

On *March 17* he reported again and a further increase in the size of the cyst was apparent (Fig. 17) with the trabeculations more pronounced. Moreover, his previous symptoms (headache, hesitant speech, subjective awkwardness of the right arm and even of the leg) had all returned. He was advised to re-enter the hospital for a secondary operation.

Third comment. Meanwhile experience from a case of another kind had taught us what to do. It was a desperate, last-minute resource in the case in question but a procedure so simple as a means of blocking a cerebrospinal rhinorrhœa of the usual spontaneous kind that I am chagrined not to have thought of it before. The case I refer to was one of those extensive meningiomata which arise from the membranes of the anterior pole of the frontal lobe, and which cause a tumor hyperplasia of the overlying bone with invasion of the frontal sinuses. In the course of the removal of the large growth together with its attached circle of dura, not only had the anterior horn of the lateral ventricle been opened but it was necessary to rongeur away the lower part of the frontal bone almost to the glabella. In this process the upper portion of the large frontal sinuses had to be removed because of their involvement in the disease.

This extensive procedure had left a huge pocket in the frontal lobe into which ventricular fluid was escaping ready to pour into the gaping sinuses which freely communicated with the nasal cavity. There was nothing but scalp to cover the large area some 6

Fig. 9. Case 2. Patient 10 days after preliminary osteoplastic frontal exploration abandoned because of infected frontal sinus. Arrow points to site of drainage.

centimeters in diameter from which the involved bone and dura had been removed.

A cerebrospinal rhinorrhœa seemed inevitable, but on the mere chance of forestalling it a piece of fascia measuring about 5 by 3 centimeters was taken from the patient's anterior tibial region and laid over the widely opened sinuses; a few fine sutures taken in the galea in front and in the margin of the dura behind, served loosely to hold the graft in place. The whole frontal cavity was then filled with Ringer's fluid; the remaining portion of the bone flap was replaced; and the scalp was sutured without a drain. There was not the slightest subsequent escape of fluid into the nose and the recovery was without any complication. The operation had been done under local anæsthesia and the only postoperative precaution was to warn against blowing the nose or sneezing.

Had this, so simple and effective a device to offset the dreaded complication of a cerebrospinal rhinorrhœa, been hit upon earlier, the lives of the first two patients might have been saved. It was put to the test in the case of Mr. H. to whose secondary operation we may now return:

March 25, 1926. Re-elevation of former flap. Extradural exposure of orbito-ethmoidal osteoma projecting through dura. Removal of intracranial projection of tumor. Disclosure of minute canal connecting ethmoid cells with the adherent leptomeninges whereby the pneumatocele could be inflated. Fascial implantation. Recovery.

Under local anæsthesia, the original osteoplastic flap was re-elevated. A needle was inserted through the dura into the pneumatocele and 40 cubic centimeters of air was withdrawn, deflating the blown-up hemisphere. The frontal dura was separated from the roof of the orbit down to the situation of the intracranial projection of the osteoma which was surrounded by the same densely adherent collar of dura encountered in Case 1. Ether narcosis was resorted to at this stage because of pain caused by the manipulations of the adherent membrane. The dural collar was then freed by careful dissection with a sharp periosteal elevator. When so freed, a defect about 1 cubic centimeter in diameter was left in the dura through which thickened and adherent pia-arachnoid could be seen.

No sign of a communication with the nasal cavity could be made out until the projecting nubbin of the osteoma (Fig. 18) was chiseled off. To one side of it there was then disclosed a minute, thread-like tube of mucous membrane about the size of a small arteriole. When the patient's nose was held during expiration a small bubble of air could be forced through the minute channel showing that it communicated with the underlying ethmoid cells.

A piece of fascia about 3 by 2 centimeters in size was then taken from the patient's leg and so placed over the orbital plate that when the frontal lobe was allowed to settle back into place it was interposed to the channel of communication. The bone flap was then replaced leaving air instead of salt solution to fill the empty extradural space due to the deflated and collapsed frontal lobe.

Postoperative notes. As after the first operation, the patient was immediately aware of the restoration of his proper mental alertness, freedom of expression, and normal movement of his previously awkward hand. The wound healed perfectly leaving as before a scarcely visible scar. An X-ray film exposed 10 days after the operation showed a small collection of residual air which had disappeared by *April 14, 1926*, when the patient was discharged.

At the present writing he has gone a year without any return of symptoms or X-ray evidence of refilling of the pneumatocele. A section of the intra-

cranial portion of the osteoma shows it to be a much more eburnated lesion than was that found in Case 1.

Final comment. The accompanying sketch (Fig. 19) was made after the operation in an effort diagrammatically to represent the conditions which had been disclosed. It might well be asked why the intra-orbital portion of the osteoma was not removed as well. This can be answered only by the admission of my own regrets on this score. I was still obsessed by the fear of establishing a cerebrospinal rhinorrhœa and wished at any cost to avoid the risk of widely opening the ethmoid cells. The growth, moreover, was small; had never given any ocular symptoms, proves to be of the eburnated variety; and may never give trouble. Should it do so, it could easily enough be removed without hazard of meningitis now that the dural opening is closed.

What may have been the mechanics of production of this peculiar and extensive pneumatocele is difficult to say. One is inclined to ascribe it in some way to the frontal injury sustained 5 years before the onset of symptoms. This injury may possibly have produced a crack in the orbital plate or separation by diastasis of the orbito-ethmoidal suture with a corresponding tear in the adherent dura. An air passage may thus have been formed without the escape (or any noticeable or remembered escape) of cerebrospinal fluid. The cerebrospinal spaces may finally have become blocked off by an inflammatory reaction leaving a small membranous canal through which air could be forced with the gradual production of the huge balloon-shaped pneumatocele which the X-ray disclosed 5 years later. A slight fracture involving the floor of the anterior cranial fossa must, however, be a very common happening, whereas a pneumatocele is excessively rare and the combination of a pneumatocele with an osteoma so far as I am aware is unrecorded.

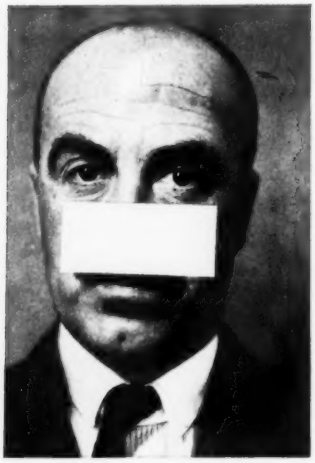
It was not until after the operative disclosures that inquiry was made of Mr. H. regarding periodic sneezing or blowing of his nose. He was unaware that his reactions were any different from those of other people.

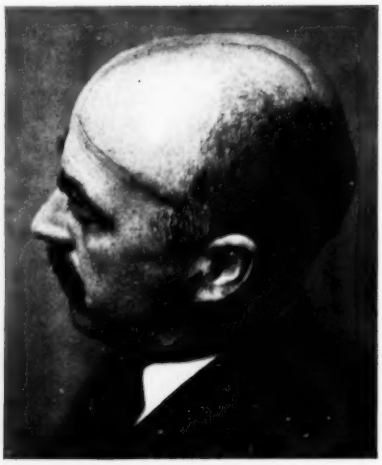
Fig. 11. Case 3. Original postero-anterior view showing the funnel shape of the cumulus-like shadow in the left frontal lobe. The osteoma does not show in this film.

But a friend who overheard this inquiry, and had been on a trip in the South with the patient during the interval between his two operations, stated, much to his companion's surprise, that he had never known a man who blew his matutinal nose so violently or with such trumpetings. Doubtless air had been thereby forced through the minute canal directly into the brain substance in amounts which increasingly exceeded the absorptive capacity of the tissues. It is remarkable that the white matter of the brain lining the cavity of the cyst showed no evidence whatsoever of any inflammatory reaction and contained no fluid.

Extracranial air cysts, commonly called pneumatoceles or aeroceles, which can be "blown up" and which communicate with one or another of the air-containing sinuses at the base of the cranium, are fairly well known. Important contributions to the subject have been made by two members of this society. Dr. L. L. McArthur[1] in 1905 reported a remarkable example of the extracranial form of pneumatocele and collected 32 cases from the literature, the majority of

[1] McArthur, L. L. Pneumatocele of the cranium. J. Am. M. Ass., 1905, xliv, 1418.





Figs. 12 and 13. Case 3. Patient 3 weeks after first operation, to show situation and size of the osteoplastic flap.

them resulting from injuries involving the mastoid cells. Dr. W. E. Dandy in a more recent article[1] which appeared shortly after our experience with the case of Mr. H., confined his attention to the intracranial collections of air for which he proposes the term pneumocephalus, and of which he has gathered 25 cases. These lesions also are usually a consequence of fractures which pass through the paranasal air sinuses.

Though the etiological factors in the production of the pneumatocele of the frontal lobe in the first case in Dr. Dandy's excellent report differed from those in the case of Mr. H., the intracranial appearance of the cystic lesion must have been very similar in both. Mr. Brödel's drawing, indeed, might well enough have served to illustrate the operative findings in both cases. Dr. Dandy, moreover, resorted to the same device, though applied in a somewhat different way, which I had also hit upon as an effective method of closing the dural defect—so simple a matter, indeed, that it would probably have occurred to any well trained surgeon in these days of fascial transplantation.

As in the famous case observed postmortem by Chiari (1884), the pneumatocele in Dr. Dandy's case had finally opened into the lateral ventricles, a complication which had apparently occurred in Case 2 of the present report though without the preliminary formation of a large intracerebral air cyst. Mr. H. fortunately had been spared this complication despite the long duration and large size of the lesion. Indeed, in none of the reported cases had the condition been so slow, so stable, and provoked so few symptoms. What is more, in none of them has the intracerebral pneumatocele been associated with an orbito-ethmoidal osteoma which, after all, is the primary subject of the present discussion.

With the experience of this man's recovery behind me I had gained sufficient confidence to operate promptly on the fourth case of the kind which ere long appeared in the clinic. The history follows:

CASE 4. Surg. No. 27976. *Orbito-ethmoidal osteoma with intradural projection and intracerebral mucocele. Transfrontal osteoplastic craniotomy. Removal of tumor through roof of orbit with opening of ethmoidal cells. Fascial stamp. Uncomplicated recovery.*

January 10, 1927. Admission of Mr. B., 35 years of age, a salesman, referred by Dr. R. K. Finley of Dayton, Ohio, with the complaint of a painful unilateral exophthalmos, failing vision and sciatica.

Anamnesis. The past history is without incident or apparent bearing on his present trouble. He has no recollection of a cranial injury, but has had

[1] Dandy, W. E. Pneumocephalus (intracranial pneumatocele or aerocele). Arch. Surg., 1926, xii, 949-982.

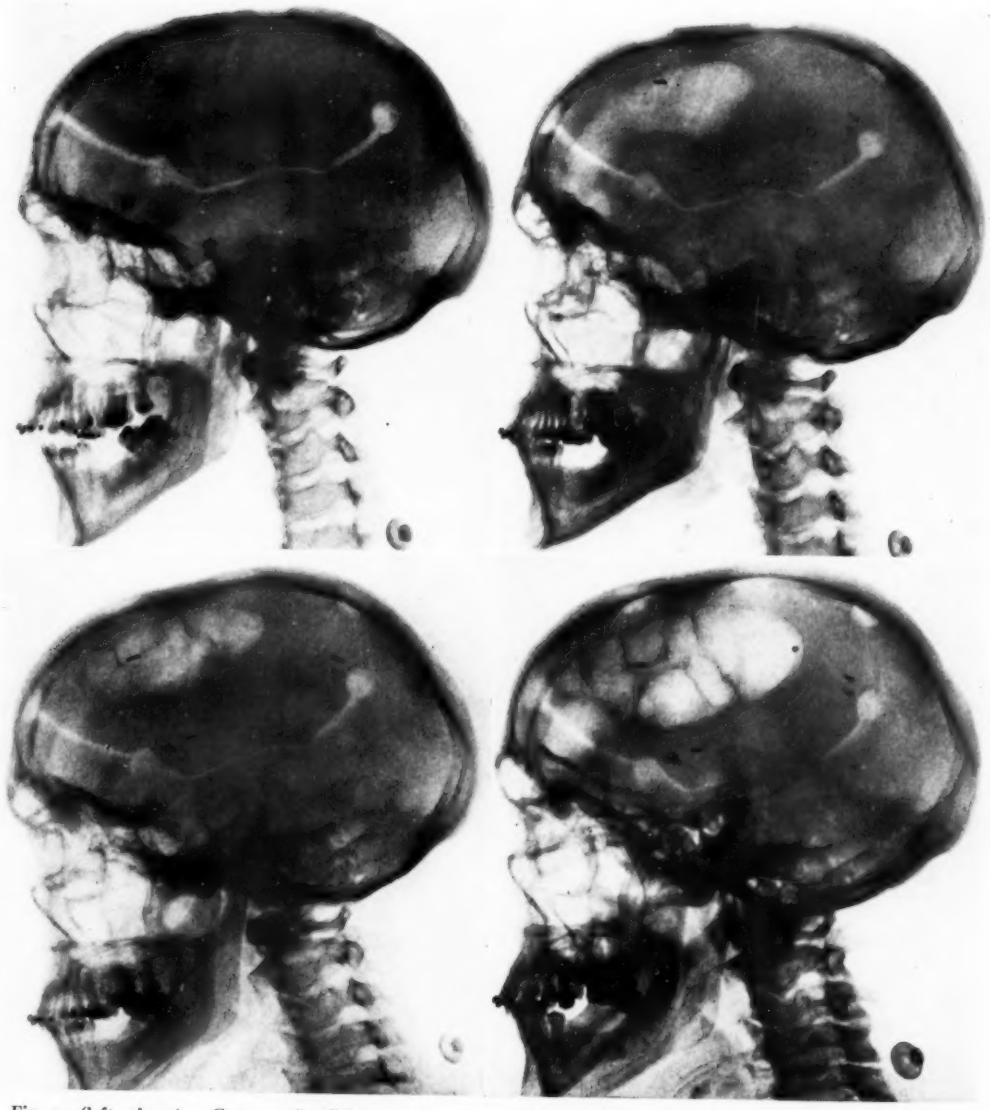


Fig. 14 (left, above). Case 3. Condition present on December 1, 1925, at the time of the patient's discharge 3 weeks after the first operation.

Fig. 15 (right, above). Case 3. Beginning refilling of the cyst first observed on January 6, 1926, 2 months after the first operation.

Fig. 16 (left, below). Case 3. Showing further and multilocular filling of cyst on February 2, 1926, 3 months after the first operation. No subjective symptoms appreciated.

Fig. 17 (right, below). Case 3. Condition found on March 17, 1926, 4 months after the first operation. Symptoms beginning to return.

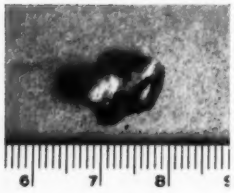


Fig. 18. Case 3. Photograph (nat. size) of the intracranial portion of the osteoma which penetrated the dura.

several bouts of otitis media (the last one in 1922), and also a succession of attacks of supposed infection of the right frontal sinus. The first of these occurred in 1910 and to the last of them he ascribes his present complaints. These began abruptly 3 months before admission (on *October 4, 1926*, to be exact) and came on in the course of a heavy cold which he had been having. The initial symptom was a sudden intense pain in the right orbit as though something were pushing against his eyeball. The acute pain subsided after a few days leaving a sensation of soreness in its wake. A week after the onset of these symptoms he had an attack of sciatica which was severe enough to confine him to bed, and from which he has since suffered considerably though he has resumed his occupation. This sciatica was ascribed to an arthritis, possibly secondary to a sinus infection. Consequently cranial X-rays were taken which disclosed an opaque tumor nodule in the back of the right orbit. There has been some loss of visual acuity.

Physical examination. This, apart from the purely local condition about the orbit, was negative in all respects except for some right-sided sciatic tenderness and a Kernig sign. There was possibly a slight exophthalmos with a little downward displacement of the eyball but no pupillary or oculomotor change. Pressure against the right eyeball, when compared with the other eye, seemingly met with greater resistance. The right disc was hazy and the vessels were engorged; the visual field was unaffected but the acuity was reduced to 20/40. The cranial X-rays showed (Figs. 20 and 21) the shadow of "an irregular bony tumor about 3 centimeters in length apparently arising from the roof of the right orbit and projecting both into the orbit and cranial chamber, its center being about 2 centimeters from the mid-line."

First comment. Here, then, was a young married wage-earner, the sole support of a family of four children, who was harboring a small benign osteoma of the orbit which, all things considered, was producing trifling symptoms and did not seriously interfere with his work. Was an operation justifiable in view of the surgical disaster in the first case, in which the circumstances were similar? Was it better judgment to wait until some complication arose which would make it obvious to all that intervention was imperative whatever the risk? The responsibility of a decision under such circumstances is heavy, as surgeons know perhaps better than others. During the 10 days he was under preliminary observation, the visual acuity dropped from 20/40 to 20/100, and this fact helped to settle the matter in favor of intervention.

January 21, 1927. Osteoplastic exploration under novocain-ether. Disclosure and removal of an orbito-ethmoidal osteoma capped by an intradural mucocele. Fascial implantation. Recovery.

Under novocain the usual right frontal osteoplastic flap was turned to the side and on elevating the dura from the roof of the orbit the circle of pachymeningeal attachment surrounding the neck of the intracranial projection of the osteoma was readily brought into view. As in the two other cases in which the tumor had been approached from above, the intracranial nodule was exposed approximately at the depth of the posterior ethmoidal cells and lay possibly 2 centimeters from the mid-line—a position, in other words, practically in correspondence with the orbito-ethmoidal suture. Though the collar of dura was dense and closely encircled the neck of the intradural projection of the lesion, it was possible with a periosteal elevator to pry the membrane free and to strip the collar over the head of the bony nodule.

The hole in the dura was kept covered and was not investigated until later.

With a chisel the roof of the orbit was then opened and the bone chipped away up to the margins of the intracranial nodule already exposed (*cf.* Fig. 4 in which conditions were very similar). Care was taken not to tear into Tenon's capsule, and the orbital contents were retracted to the side. It was then possible gently to rock the tumor (Figs. 22–25) out of its bed and to dislodge it. In so doing an irregular portion of the growth extending into the paranasal sinuses came away together with the adherent mucous membrane, leaving a large opening into two of the ethmoidal cells. There was an immediate passage of air from the nose and some bleeding from the torn mucous membrane which was checked by a pledget of cotton wet with adrenalin solution.

Further investigation within the orbit showed that there was a thin scale of bone, evidently the displaced outer wall of the ethmoid cell within which the main intra-orbital portion of the tumor had been pocketed. The scale of bone (Fig. 25) was easily removed and the compressed orbital contents promptly expanded to fill-in the cavity. On the basis of this finding, the growth had originated on the nasal rather than the orbital side of the septum.

During this stage of tumor enucleation, the opening in the dura had been covered by the spatula used for the purpose of elevating the lobe (*cf.* Fig. 4). On withdrawing the spatula at this juncture a most surprising thing happened. Through the small opening there escaped a mass of stringy mucus and following it the capsule of a mucocele, which must have been about the size of a hickory-nut, extruded itself. Cerebrospinal fluid then for the first time escaped from the dural opening. The approximate situation of the lesion and its complicating mucocele is shown in the sketch (Fig. 26).

The ragged opening in the dura was not in a position where it could have been closed by sutures. Consequently a stamp of fascia was taken from the patient's leg, and this was laid over the opened ethmoidal cells, and the dura was allowed to fall back into position over it.

For a few hours, there was some discharge of bloody cerebrospinal (?) fluid from the nares but the discharge soon ceased. The convalescence was without incident except for a temporary diplopia which disappeared in a few days. There was perfect wound healing (Figs. 27 and 28). Normal vision was soon regained. The sciatic discomforts promptly subsided and when discharged on *February 12, 1927*, he was quite symptom-free.

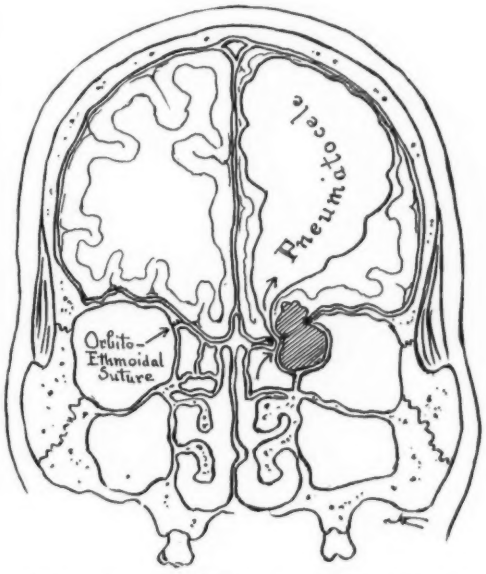


Fig. 19. Case 3. Diagram to give the operator's impression of the site of the communication between the ethmoidal cell and the pneumatocele.

DISCUSSION

I have endeavored to present in their chronological order a series of experiences with a peculiar lesion—described herein as an orbito-ethmoidal osteoma—with which, until 3 years ago this present month of May, I was entirely unfamiliar. Since then four examples of the condition have come under observation. All four examples were in men, three of whom had the scar of a frontal scalp-wound received some years before. What is more, three of the patients sought hospital care because of intracranial symptoms which were bizarre and seemed difficult to explain.

From lack of knowledge concerning the actual relation of the osteoma to the intracranial symptoms, the first two of these patients succumbed. One died from infection due to failure to close-off the communication between meninges and nasal cavity at the conclusion of the operation; the other died in consequence of surgical procrastination. It is clear, from what has subsequently been learned, that both of these patients might have been saved by a comparatively easy operation safeguarded by a single maneuver.

Certainly in the future it will be far better immediately to operate upon and to remove these ethmoidal osteomata so soon as they are picked up by the X-ray. If they are neglected not only may the more familiar intra-orbital complication arise, but hitherto little understood intracranial ones. In this small series alone, a cerebrospinal rhinorrhœa communicating with the cerebral ventricles, a huge intracerebral pneumatocele and an intradural mucocele have all been observed.

Whence, may well be asked, does the original tumor arise and what is the significance of its apparent relation to a preceding injury? Doubtless mild frontal injuries may, more often than suspected, produce a fissured fracture of the thin floor of the anterior cranial fossa; or, if not a fracture, a diastasis of the suture between the orbital plate of the frontal bone and the adjacent edge of the ethmoid bone roofing the ethmoid cells. It was at this point of union that the intracranial projection of the tumor was found in all four of these cases, and it is not inconceivable that some quiescent cartilaginous anlage may have been stimulated to bone-production activity. This at least was

Fig. 20. Case 4. Right lateral roentgenogram to show shadow of orbito-ethmoidal osteoma (nat. size), indicated by arrows.

Virchow's view which perhaps is good enough for most of us.

In that classic of our medical literature, "Die Krankhaften Geschwuelste"[1] Virchow attributed to Cruveilhier the merit of having described, under the name of "corps osseux enkystes," certain of the bony enostoses which have characteristics distinguishing them from the exostoses. Cruveilhier had based his conclusions on the study of three furrowed, irregular, and warty bone-tumors of the fronto-orbito-ethmoidal region, so placed in the inside of the bones as to push out the inner table before them like a plate. And Virchow goes on to say:

[1] Vol. ii, pp. 37 and 42 *et seq.*

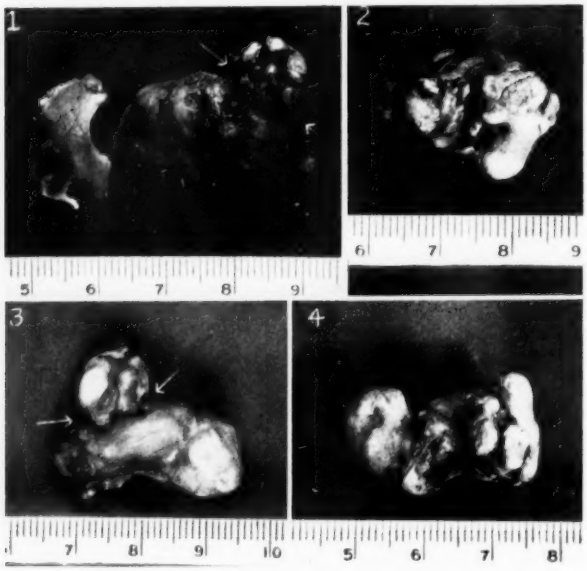
Although there is scarcely any part of the orbit where these bone-tumors have not been found, the upper and inner part, however, are by far the most frequent sites. These are the two regions which in relation to their original development show the greatest complication. On the one hand, there are the frontal sinuses the development of which continues into a relatively late period of life. On the other hand, the union of different bones to each other, namely the frontal bone, the maxillary bone, the ethmoidal bone, etc., is so complex that different disturbances during development can very easily occur. In addition there is the proximity of the nasal cavities and the tear ducts, from which entirely distinct maladies can arise, and spread to the neighborhood. It is, therefore, not only understandable how these regions often become the seat of disease but also how difficult it may subsequently be to determine whether a tumor has originated primarily in the nasal or frontal sinuses or in the

Fig. 21. Case 4. Postero-anterior roentgenogram (print reversed) showing situation of osteoma. Shadow indicated by arrows.

orbital cavity; whether it comes from the inner or outer surface of the bone; finally whether it originates from the frontal or ethmoidal bone or somewhere else. For all of these possibilities there is evidence in the literature, without its being always possible to determine the correctness of either opinion. For a tumor which arises from the interior of the frontal bone can very well later on project into the frontal, orbital, nasal, or cranial cavity. . . .

And from this general description Virchow proceeds to describe certain of the more famous cases in the early literature, like those reported by Weiss, by Rokitansky, by Busch, by Knapp, by Baillie, and by Paget, all of them being cases of ivory osteomata which had reached such a very large size as to make their primary origin indeterminable when they came to be studied after the patients' death.

Today fortunately the X-ray comes to our aid and we may recognize these tumors before they have reached such a formidable size as those which Virchow described. If they all actually arise from the paranasal air sinuses, as they seem to, one would naturally expect that intranasal complications, caused by the backing up of nasal secretions with the production of mucoceles, would be the primary incident to attract attention. Yet the rhinological literature is strangely silent in the matter and it would appear that intranasal inspection gives no clue to the diagnosis. Certainly no sign of the tumor was apparent on an intranasal examination in any of our four cases. In one of them, indeed, the ethmoid cells, on the assumption that they were infected, had been surgically explored without disclosing the osteoma.



Figs. 22–25. Case 4. Showing (nat. size): (1) anterior view of tumor, together with inner wall of orbit (lamina papyracea) which had been pushed ahead of its intra-orbital projection; (2) inner surface of tumor; (3) posterior surface of tumor; and (4) lower surface of tumor. Arrows in Figures 21 and 23 indicate neck of intracranial protrusion.

Even if discovered, one can hardly imagine such a lesion being preferentially attacked through the nose, which may account for its not having aroused the interest of the rhinologist.

Hence the field has been left apparently to the ophthalmologist, but the usual method of approach through the orbit favored by ophthalmic surgeons is an awkward one, and they have usually contented themselves with chiseling off so far as possible the intra-orbital portion of the growth, a procedure doubly difficult on account of the eburnated character of the lesion and its inaccessibility when approached from in front. It may sometimes be necessary, according to Professor Fuchs, even to enucleate the eye as a preliminary step. Neither method of approach, whether by nasal or orbital route, makes allowance for the possibility that the tumor may possibly have extended into the intracranial chamber.

These orbito-ethmoidal osteomata are unquestionably rare, or at least are rarely recognized. In a comprehensive article on the subject in the days before Roentgen's discovery, Joseph A. Andrews[1] stated that in approximately 500,000 cases studied in the ophthalmological hospitals of New York only eight examples had been recorded. One

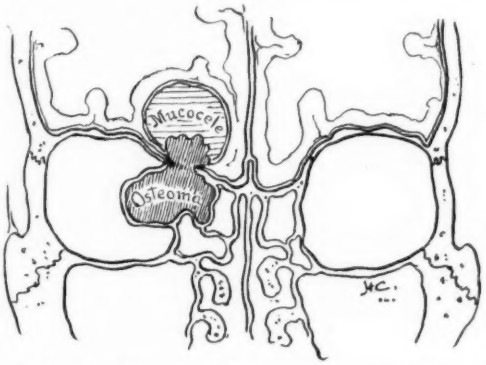


Fig. 26. Case 4. Diagrammatic representation of situation of osteoma and its intracranial mucocele.

[1] Andrews, J. A. Successful removal of two osteomata of the orbit, etc. Med. Rec., New York, 1887, xxxii, 261–274.

Figs. 27–28. Case 4. Patient 12 days after operation, showing inconspicuous scar, and normal condition of eyes.

would suppose that the number of recognized cases would have been greatly augmented by the introduction of the X-ray. It nevertheless is unusual for roentgenologists to pick up these lesions in their pre-symptomatic stage, even in special hospitals for diseases of the eye, ear, nose, and throat, where one would expect them to be observed if anywhere.

Dr. A. S. MacMillan, the roentgenologist of the Massachusetts Eye and Ear Infirmary, informs me that in the course of the last 7 years, with the examination of upward of 15,000 sinuses, he has occasionally seen symptomless pea-like osteomata of the frontal sinus but has only known of one of the lesions in question. In this instance the diagnosis of osteosarcoma had been made from the roentgenograms and Dr. D. Crosby Greene approached the growth by removal of the "lateral wall of the nose, inner wall of the orbit, inner half of the floor of the orbit, anterior wall of the antrum and naso-antral wall." This exposure, according to Dr. Greene's account, brought to view "a hard, irregular bony tumor of the size of an egg which appeared to arise chiefly from the anterior surface of the sphenoid bone." Evidently there was no intracranial communication and the patient made an excellent recovery.

That four examples of these supposedly rare osteomata should have come so recently under observation in one clinic suggests that they may, after all, often be overlooked or go unrecorded. This is the more likely since these four cases all had an intradural projection of the lesion with secondary complications, whereas the number of cases without intracranial complications must be vastly greater.

How often the lesion may, therefore, have been overlooked in the past it is impossible to tell.

The writers of ophthalmological textbooks warn their readers against the likelihood of setting up a meningitis when these tumors have been operated upon in the usual way. Certainly in the cases herein recorded, if the osteoma had been approached through the orbit and "rocked" out of its bed, it would have left a tear in the dura and a direct communication between the meningeal fluid spaces, the nose, and the orbit. From the past accounts of these operations in the literature, this cannot have been an uncommon happening.

Whatever may be the surgical views of those who specialize in the disorders of the eye or nose in regard to these orbito-ethmoidal osteomata, the neurosurgeon would certainly prefer to get primarily to windward of the lesion before attacking it, rather than to beat his uncertain way through the nose or the orbit, not knowing what troubles will be in store for him with the tumor dislodged.

So, in closing, may I be allowed to return to the subject of my preamble. The lesion under consideration arises apparently from the ethmoid cells. It would supposedly, therefore, lie in the province of and be primarily detected by those who specialize in diseases of the nose and throat. As a matter of fact the secondary symptoms from intra-orbital pressure send the patient as a rule primarily to the ophthalmologist who in the past has courageously and often successfully attacked these lesions from in front, with the removal at least of its intra-orbital portion.

It is evident, however, that certain of these ethmoidal osteomata, perhaps the majority of them, ultimately lead to intracranial complications of one sort or another. They consequently may fall into the hands of those whose special training makes them more at home in the cranial chamber than in the orbit or recesses of the nasal air passages. So do our surgical specialties overlap. The only safeguard for the patient, as I see the matter, is for all who engage in surgical specialization to have had a thorough preliminary grounding in the principles of general surgery, for no one can possibly foretell into what difficulties or into what adjacent and unfamiliar territories his chosen specialty may lead him.

HELIOTHERAPY IN SURGICAL TUBERCULOSIS[1]

By NATHANIEL ALLISON, M.D., F.A.C.S., Boston, Massachusetts

THE use of sunlight in the treatment of disease is not a new thing. The use of the word "heliotherapy" in describing sun treatment, however, is new, and about the use of this word many newly-formed ideas and conclusions have clustered. The word "heliotherapy" has gained world-wide usage and significance, coming to mean to the minds of many the essential form of treatment in surgical tuberculosis. Indeed, a mental picture is called up by the word "heliotherapy" which shows naked, dark brown, well nourished children extraordinarily active and happy, playing about in the snow in the Alps,—it is evident that the children have tuberculous lesions of the bones and joints. To those of us who are old enough to remember our hospital wards and out-patient departments of 25 years ago, a very different visualization is possible; pale, emaciated children with pinched faces, increasing deformities, abscesses, amyloid degeneration, general miliary tuberculosis, meningitis, and death. A striking contrast, looking first on this picture and then on that. This remarkable change is due, perhaps, to many things, but in its production so-called heliotherapy beyond a doubt has played an important part.

In order to make reliable observations upon any form of treatment, something must be known of the disease process under treatment, especially of its cause, and of the reaction of the human organism to that cause.

Surgical tuberculosis includes the manifestations of tuberculosis which, by long established tradition, have been regarded as surgical lesions, that is, lesions which are so localized as to be amenable to surgical treatment. Notable in this group are the bone and joint lesions, kidney tuberculosis, glandular and skin lesions, eye infections, and rarer forms.

Tuberculosis is a disease process due to invasion of the organism by the tubercle bacillus.

In the various forms of the disease which are called surgical tuberculosis, the disease process has become localized in some tissue and gives local evidence of its presence. For instance, spinal column, hip, knee, ankle—involving both bone tissue and joint structures. The process of localization is accomplished by the blood stream. The tubercle bacilli, having gained a foothold in the glandular structures, are carried to the bone marrow or synovia and take up activity at these points. This, of course, is well understood, but nevertheless it is not generally realized that localized tuberculosis is only a sign of a general disease process.

The forward step which heliotherapy gave to the treatment of surgical tuberculosis depended entirely upon the realization that the local disease process is of secondary importance, and that the treatment of a tuberculous individual is the matter of prime consideration. That this is true, most of us can bear witness, remembering as we do the time when a child with Pott's disease was treated with a brace or a plaster jacket; when a tuberculous hip or knee was treated by braces and radical surgical procedures.

Tuberculosis is now recognized as a disease process which must be fought by raising the powers of resistance to the highest possible level in the infected individual. Granted that the virulence of the tubercle bacillus does not greatly vary, shown by the experimental work of Eastwood and Griffith (2), and by Allen K. Krause (5) who says that the net result of many studies on virulence has been to emphasize all the more a fixity of bacillary type and potentialities more marked perhaps than for any other known bacterium, then we must conclude that the variations in the disease process are due to a greater or lesser resistance in the individual. Zinsser (8) has stated that all attempts at active immunization of man against tuberculosis have been entirely unsuccessful. "Fortunately for the human race the problem is being attacked along sanitary and hygienic lines, attention to nutrition, personal and community life,

[1] Read before the Southern Surgical Association, Biloxi, Mississippi, December 15, 1926.

Fig. 1. The New England Peabody Home for Crippled Children, Newton Center, Massachusetts. The building is placed on the south side of a high hill and is constructed so that it lies in the path of the sun, facing due south, insuring the maximum of sunlight on all of the porches.

and is being attended by astounding results." Zinsser believes that the essential mechanism of resistance to the tubercle bacillus may be found in the activity of the cells making up the specific inflammatory reaction, which is recognized as the "tubercle." There may be here formed a substance of an enzymelike nature, certainly not identical with ordinary antibodies. It may be that the insolubility which is conferred on the tubercle bacillus by its waxy and lipiodal constituents necessitates the production of a mechanism basically different from that which underlies the resistance to other bacteria, and it may be that the tissue mechanism around the tubercle is the part of the story which concerns resistance to the bacilli in their acid-fast condition (8). Krause (6) points out from his experiments on animals with tuberculosis that there is a definite ability to "fix" the bacillus in the tissues. He regards this as a specific immune reaction produced only by infection with the tubercle bacillus, and that it represents an *allergy* or allergic state. Animal or human individuals who are in this state of allergy have a favorable reaction to re-infection, quickly checking the spread of the disease. This allergic state is reduced by fatigue, anæmia, and other bacterial infections. It seems justifiable to assume, therefore, that any and all means at our disposal which may raise the individual resistance to tuberculosis are the means to be employed.

There is an abundance of clinical evidence that so-called heliotherapy will raise the resistance of the tuberculous patient, especially in the localizations of the disease which are known as surgical tuberculosis. As has been suggested, there is a widespread belief in the wonderful results which follow exposure to the sun. The reasons for this belief may be summarized in a review of observations made during the summer of 1926 at the clinics of Rollier in Leysin, Switzerland, Sir Henry Gauvain at Alton, W. Rowley Bristow at Pyrford, and G. R. Girdlestone at Oxford, England, and at the New England Peabody Home for Crippled Children in Newton, Massachusetts, U. S. A.

Rollier (7) has so frequently voiced his belief in the curative value of heliotherapy that repetition seems unnecessary. In his *La Cure du Soleil* (1915) his views are clearly stated and need no emphasis from others. In brief, the impressions gained by a visit to his clinic are as follows:

Surgical tuberculosis is absolutely cured by heliotherapy.

The rays of the sun act most effectively at an altitude of three thousand to five thousand feet above sea level.

Artificial light is valuable, but is not to be compared with the rays of the sun.

Climate has influence, in that bracing fresh air is valuable.

The treatment, to be most effectual, demands an abundance of sunlight and exposure of the skin to the sun.

The exposure of the skin, the skin being made use of as an organ, is of the greatest

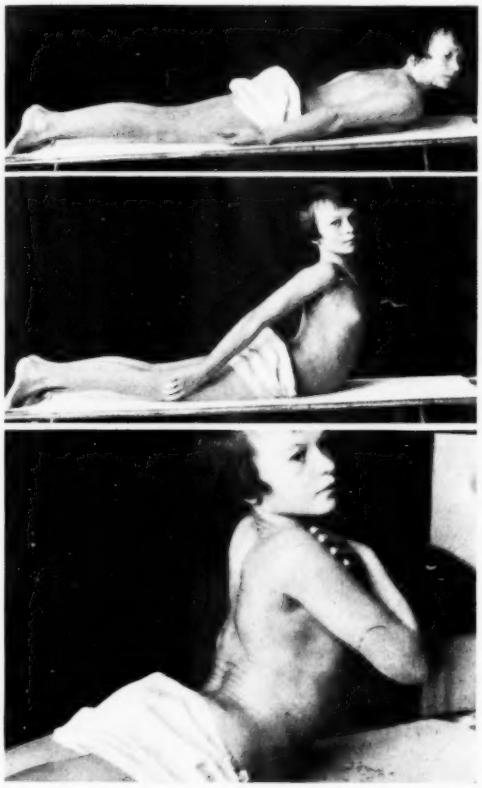


Fig. 2. Tuberculosis of the spine, dorsolumbar disease. A, B, and C show the type of exercise taken daily to strengthen the erector spinæ group of muscles.

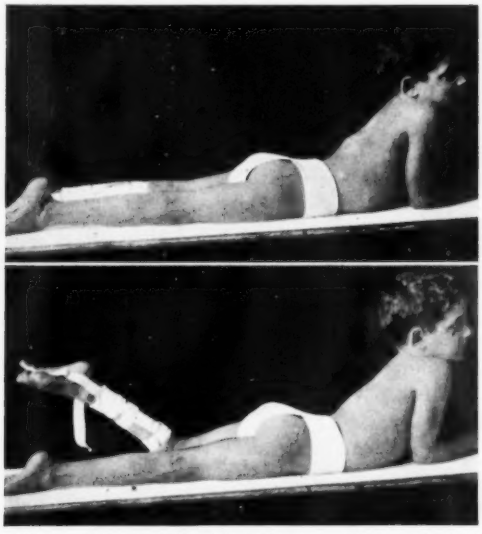


Fig. 3. Tuberculosis of the left knee and tuberculosis of the spine. With light traction and voluntary muscular exercise, 45 degrees of painless motion has returned to the affected knee joint.

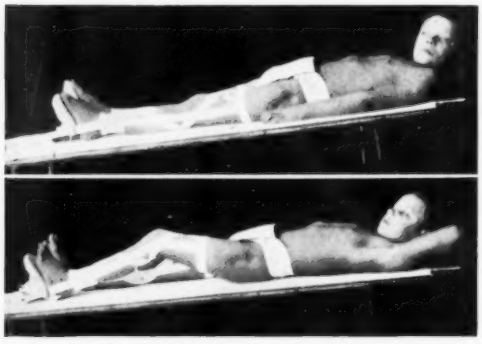


Fig. 4. Tuberculosis of the hip. In this instance both hips are tuberculous, with discharging sinuses. On entrance no motion was allowed in either hip and it seems that ankylosis had been established. With light traction and voluntary muscular exercise, painless motion has returned to the affected hip joints.

importance. The skin has powers of elimination, circulation, innervation, and nutrition. Where the skin is well browned, and its capillaries are used to draw the blood from the deeper layers, the muscles and joints regain their former tone, and the lesions in the bone and joint structures heal. Abscesses calcify, and complete *reconstruction* takes place in time. This healing process is aided greatly by functional use of the muscles. Very soon after gradual exposure of the skin, following a routine which exposes the lower extremities first, pain and discomfort cease and healing sets in.

The great disaster is multiple infection. Consequently, abscess formation is severely let alone until the abscess content reaches the subcuticular region. Then, and not until then, the abscess may be aspirated.

The great catastrophe of surgical tuberculosis is surgical interference, both in adults and in children. Rest, with the patient exposed in the sunlight, is the necessary treatment. The length of time required for cure is not an

Fig. 5. Tuberculosis of the tarsus. In this instance there was extensive involvement of the tarsal bones, proved tuberculous by guinea-pig inoculation and tissue examination. With protection from weight bearing, voluntary use of the muscles of the leg, and heliotherapy, there has been steady and marked improvement of the tarsus.

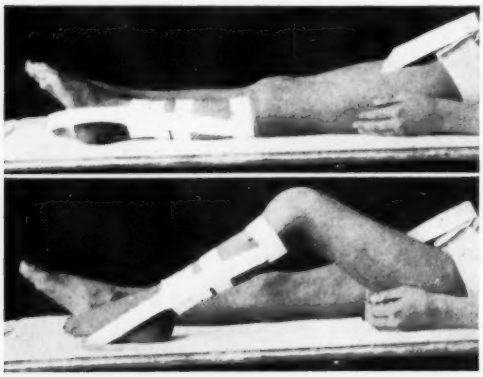


Fig. 6. Tuberculosis of the knee. Light traction, heliotherapy, voluntary use of the muscles, and return of 40 degrees of painless motion in the affected knee joint.

Fig. 7. Tuberculosis of the hip, with multiple infection, many sinuses, and amyloid degeneration. In this instance the child's resistance has not been raised by heliotherapy.

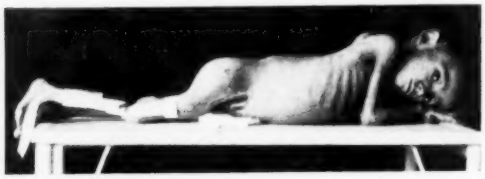


Fig. 8. Lumbar Pott's disease with psoas abscess, multiple infection, amyloid degeneration, tuberculosis of the skull, and tuberculous peritonitis. In this instance heliotherapy would not raise the child's resistance.

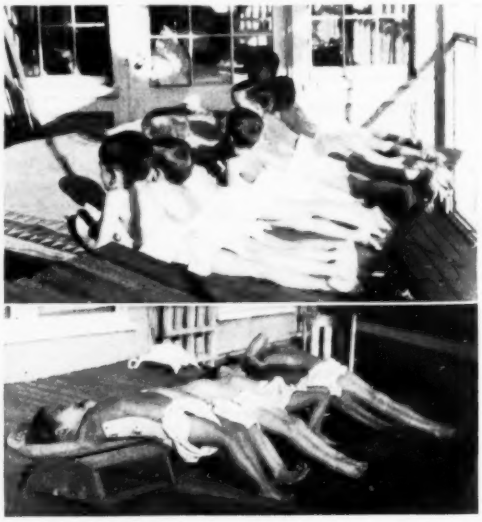


Fig. 9. Children with Pott's disease being treated by heliotherapy. The spine is held in hyperextension by a molded plaster jacket (Ghormley type). The front half of the jacket is used when the back of the body is treated and the back half of the jacket when the anterior surface of the body is treated.

argument to be used. Surgical interference is dangerous at best and leads to disaster in most instances, except one—renal tuberculosis demands removal of the tuberculous kidney. Thus it is that for periods of time ranging from 2 to 10 years, patients are treated by means of heliotherapy at Rollier's clinic. Intermissions in the treatment are dangerous. "Complete cure is finally accomplished." It is judged by the roentgenographic records. Indeed, the matter of resumption of function is decided by the roentgenologist, who purposely has no clinical knowledge of the progress of the individual. When the X-ray plate shows "reconstruction" of a joint, or sufficient "bloc" about diseased vertebræ,

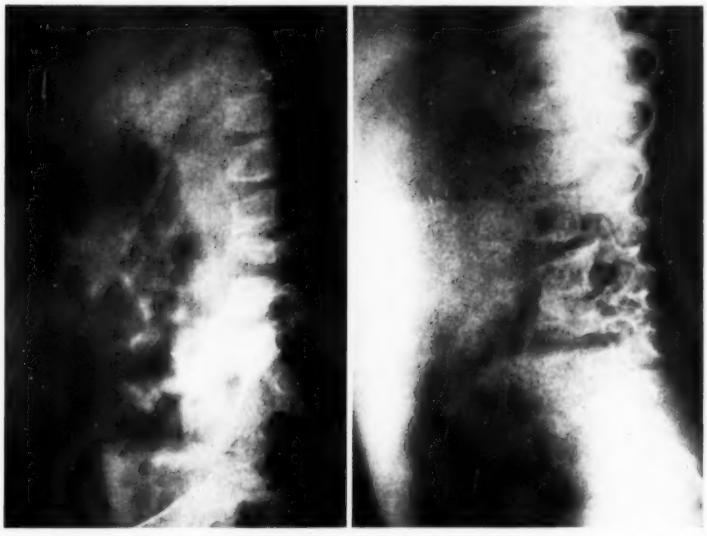


Fig. 10. Lumbar Pott's disease. Roentgenogram at left, taken in 1923, shows involvement of the second, third, and fourth lumbar vertebræ. Roentgenogram on the right, taken in 1926, shows fusion of the bodies of these vertebræ with lessening of deformity. Treated with heliotherapy.

then it is decided that the patient may be up and about. Recumbent patients use their muscles and move the diseased joints as much or as little as they wish. Spinal disease is treated by recumbency, without braces or jackets. Hyperextension of the spine is actively encouraged so that the erector spinæ muscles become well developed and strong. During convalescence, the apparatus used for protection is of the lightest type possible—celluloid or linen splints only.

Without entering upon a discussion of the various effects of the sun's rays, their photochemical power, or their bactericidal possibilities, suffice it to say that Rollier believes the greatest good comes from this source. He believes that tuberculosis of the bones and joints is cured by this agency, acting on the skin, and that this form of treatment is that which should be given to all cases of tuberculosis in its so-called surgical manifestations.

Much credit is due Rollier for his admirable contribution to the cure of surgical tuberculosis.

Observations made last summer incline the writer to believe that the diagnosis of tuberculosis is correct in the vast majority of Rollier's cases, that what he claims for the sun's rays is in part true; that the situation of his clinic in the high Alps, with clear bracing and stimulating air, coupled with *rest*, exposure to air, and good food, have much to do with the admirable results very evident at this clinic. Unfortunately, there is no record of failure or of lack of improvement, and this I wish especially to stress. There is always the possibility that unfavorable results are due to causes beyond control, meaning by this that a case which has not improved under his treatment owes this to multiple infection, to surgical interference, or to poor co-operation.

One feels that Rollier believes that heliotherapy is not to be blamed for an occasional failure. It may be said that in Rollier we have an enthusiast who realizes from his own extensive experience that surgical tuberculosis is much improved and at times cured by the methods of treatment he uses, and which he calls heliotherapy. His optimism and wholehearted enthusiasm for heliotherapy are both understandable and pardonable when

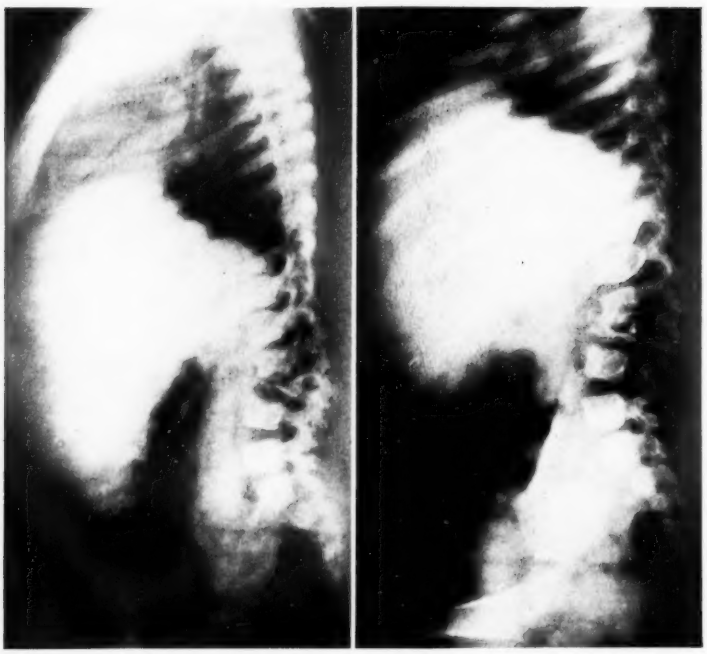


Fig. 11. Tuberculosis of the lumbar spine. Roentgenogram at left, taken in 1924, shows involvement of the first, second, and third lumbar bodies. Roentgenogram at right, taken in 1926, shows fusion of these bodies with lessening of the deformity. Treated by heliotherapy.

the immense value of his contribution is justly considered.

In England, the observer is at once struck with the fact that although surgical tuberculosis is there treated at sea level, with comparatively little sunshine, nevertheless the results of heliotherapy are as good as if not better than those seen in Switzerland at Rollier's clinics. This observation will, I am sure, demand substantiation, and the most outstanding evidence is supplied by the work of Sir Henry Gauvain (3) at Alton. At this hospital one sees browned children, whose bone and joint lesions are quiescent, up and about with well nourished bodies, having been transformed from pale, suffering children with active, progressive, localized tuberculosis into children with lessened deformity and no evidence of active disease. Gauvain and his associates utilize all the sun that can be used, and supplement the lack of sun with various forms of artificial light, i.e., carbon arc, mercury vapor, and Finsen-Reyn lamps. The disease process is treated locally, and the patient is treated as a whole by the rays from these various lamps. Added to this are rest, proper surgical treatment in the way of protection, and fixation, carried out under the direction of Mr. H. A. T. Fairbank, good food, fresh air, sea-water bathing, and exceptionally healthful surroundings. The results are equally good if not a shade better than the results at Leysin. One feels that Sir Henry Gauvain is also an enthusiast and an optimist, with a leaning toward the efficacy of artificial light in surgical tuberculosis. He, however, is modest in his optimism. He says: "With regard to the final results of treatment, it is difficult at present to make any very valuable estimate, as the results must be gauged by their permanency. Up to the present they have been quite satisfactory."

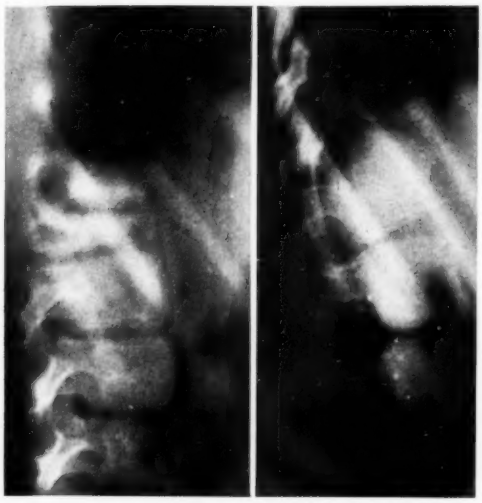


Fig. 12. Tuberculosis of the eleventh and twelfth vertebræ. Roentgenogram at left taken in 1923. Roentgenogram at right, taken in 1926, shows fusion of the bodies of the diseased vertebræ. Treated by heliotherapy.

Another thing one observes at Alton is the earnest attempt to discover by blood examination and careful physical records what changes are taking place in the individual under treatment. Judged by the results of treatment, one feels that Gauvain and his associates are justified in their optimism and enthusiasm. They deserve the great credit of demonstrating that surgical tuberculosis may be successfully treated at sea level in a country with limited sunlight as well as in higher altitudes with plenty of sun. This in itself is a contribution to the subject of the first magnitude.

At Pyrford in England, W. Rowley Bristow (1) also demonstrates the truth of this, as does Girdlestone at Oxford.

In England, the attitude of those interested is well put by Girdlestone, as follows: "A tuberculous focus in a bone or a joint is obviously part of a deep-rooted disease, serious in itself, crippling if there is delay, disastrous if there is neglect. Modern treatment means the use of rest, food, and weather, which if started in good time and kept up long enough will almost always bring about a cure. Modern treatment necessitates a special open-air hospital, and a staff experienced and technically expert. There is no need of sending patients to distant hospitals."

Our own experience at the New England Peabody Home for Crippled Children has demonstrated, to us at least, that so-called heliotherapy is essential to the proper treatment of surgical tuberculosis. At this hospital, beautifully situated in the open country, every possible advantage is taken of sunlight. In the environs of Boston, at sea level, with much cold wind and snow in winter, and a heavy annual rainfall, the Weather Bureau tells us that we have a yearly average of 57 per cent sunshine, that during November, December, and January it falls to 48 per cent, and that June to October shows about 63 per cent of sunshine. Ghormley (4) has shown by weight charts that the weight of the patients increases most in the months with the higher percentage of sunshine, and we note without doubt a slowing up in the winter of each individual's resistance. However, it is clear to our minds that heliotherapy is successfully carried out; indeed, that our results run exactly parallel to those of Rollier, and those in England.

To be more specific. We have noted that our cases of spinal tuberculosis as reported by Ghormley show the following: success in improving deformity depends upon the regional localization and upon the extent and duration of the disease. For instance, cervicodorsal, no improvement; upper dorsal, 30 per cent improved; mid-dorsal, 50 per cent improved; low dorsal and dorsolumbar, 66 per cent improved; lumbar, 90 per cent improved. The extent of the disease has much to do with this, practically complete correction of deformity is possible where only two adjacent vertebral bodies are diseased.

Hips and knees have healed to the extent of allowing weight-bearing function, and with no active symptoms.

Tarsal involvement has uniformly responded by marked improvement.

Spina ventosa finally heals, with little disturbance of function and surprisingly little deformity.

On the other side of the page, however, we encounter patients with tuberculous bone and

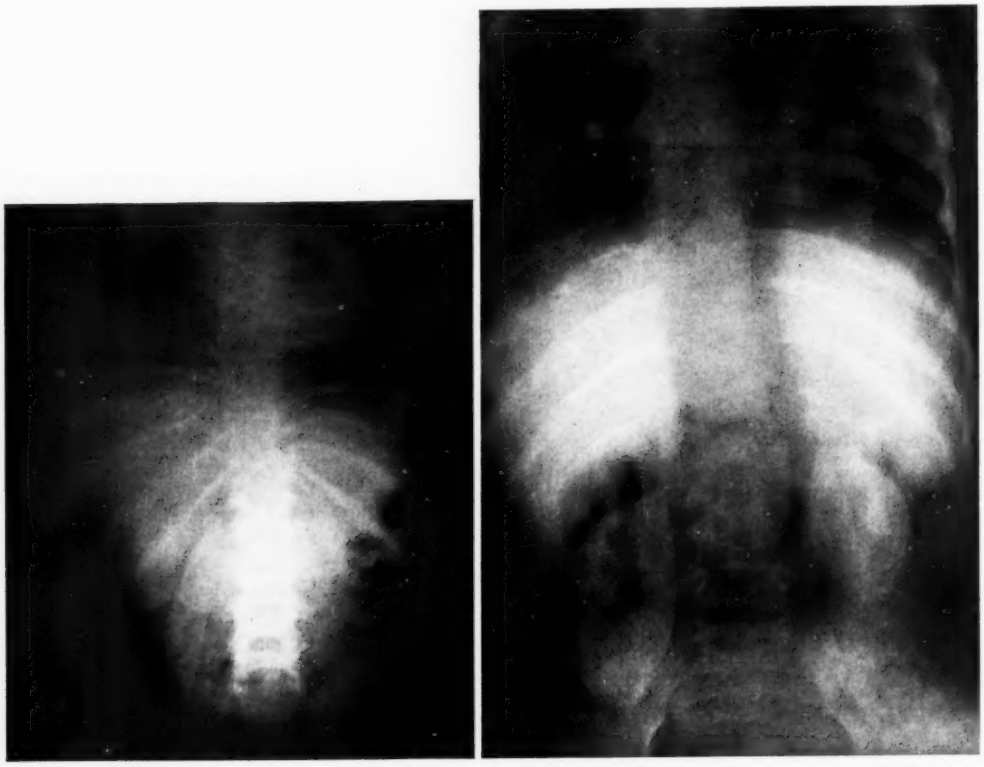


Fig. 13. Tuberculosis of the spine treated by heliotherapy. Note the calcification of the psoas abscess. It has been found in many instances that psoas abscess treated by heliotherapy undergoes complete calcification. This indicates definitely that abscesses should not be interfered with surgically on account of the danger of multiple infection. In the presence of multiple infection, calcification does not take place.

joint disease who do not respond to heliotherapy, who develop abscesses, have multiple infection, amyloid degeneration, and either die of tuberculosis or of some intercurrent infection. Perhaps I am fair at placing this group at about 5 per cent of our cases.

Heliotherapy in our hands is somewhat similar to that practiced at Leysin. We believe it to be made up of the following constituent factors: rest, good food, fresh air, surgical protection to diseased areas, happy surroundings, and light, both sunlight and artificial light. Added to this we have employed transfusion of blood with benefit in many instances. Heliotherapy, therefore, to our minds, is a composite of many things which are aside from the light element, not in any way connected with the sun's rays. This combined effect of many factors produces good results, because by it the resistance of the individual to tuberculosis is raised to a point which represents a lessening of the power of the bacillus to invade new territory, and a heightening of the power of the tissues to wall off and to fibrose the areas already occupied.

The end-results of heliotherapy are as yet to be estimated. How much and how permanent healing takes place we do not know. Enthusiasm over what is now accomplished at institutions where these methods of treatment are carried out may lead to the belief that tuberculosis in its surgical manifestations is a conquered disease process. Disappoint-

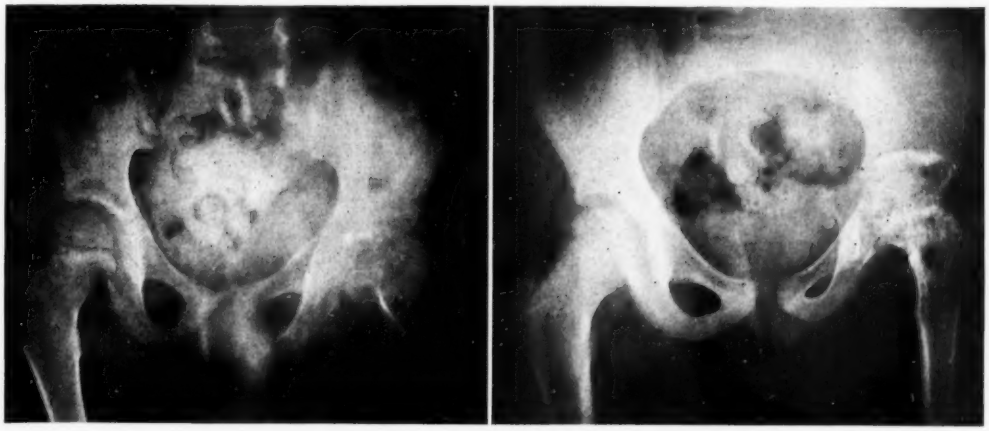


Fig. 14. Tuberculosis of the hip. Roentgenogram at left, taken in 1924, shows diffuse inflammation of the head of the femur and the acetabulum. Roentgenogram at right, taken in 1926 after 2 years of heliotherapy, shows marked improvement in the character of the bone structure, as evidenced by the roentgenogram.

ment, it seems, will surely be the result of this belief. At present, surgery has a definite part to play in the cure of tuberculosis. We know enough of the healing process in the tissues to realize that bone and joint destruction is the typical lesion of this disease. We know also that the healing of the lesions requires the filling in of the destroyed areas by fibrous tissue; also, that joint cartilages once destroyed are not in any sense regenerated, and that ankylosis in good position is a fortunate result in many instances. Operations designed to assist nature in this healing are useful and result frequently in apparent cure, with lessened periods of invalidism.

An inconclusive argument may arise as to the value of the time element in the cure of tuberculosis. I am one of those who hold that in children with bone and joint tuberculosis the time element may be largely disregarded. On the contrary, in adults and young adults I believe the time element is of great significance, especially when ultimate cure implies the final ankylosis of a joint. In these statements I differ widely from the beliefs of the heliotherapeutic enthusiast, because I do not believe that extensively diseased joint areas may be reconstructed—a term of Rollier's—by the sun cure. I will gladly believe that in children taken early in the disease joints may be saved to useful function—this is a consummation much to be desired. Consequently, I believe that operative surgery is not indicated in tuberculosis of the bones and joints until methods of heliotherapy have been employed for long periods of time.

The differences which arise in the discussion of this problem have origin in our fundamental point of view regarding tuberculosis. If one has knowledge of the possible duration of this disease process in the tissues, especially in such tissues as bones and joints, he will be

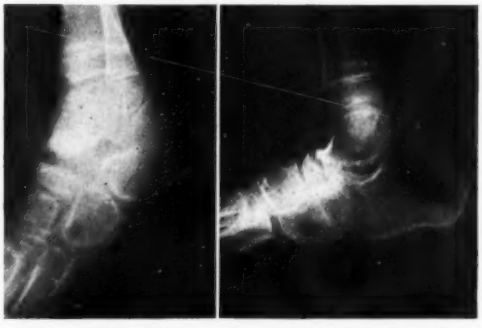


Fig. 15. Tuberculosis of the tarsus. Roentgenogram at left, taken in August, 1925, shows marked destruction in the neck of the astragalus and scaphoid with involvement of the os calcis. Roentgenogram at right, taken in July, 1926, shows marked improvement. This type of improvement is called by Rollier "joint reconstruction."

Fig. 16. The majority of these children have resisted tuberculosis to the extent that they are up and about, functionally using their bodies, without active symptoms. They are, as a rule, strong, well nourished, and show the improvement which results from the use of heliotherapy—heliotherapy which represents a combination of many factors, such as good food, fresh air, rest, and protection, sunlight, and artificial light.

inclined to believe that lack of clinical symptoms and signs of the disease may represent only a period of quiescence, and that the ultimate healing of a tuberculous lesion requires long periods of high resistance to the disease. The actual lesion of tuberculosis in the bone and joint structure will remain destructive in character, and the amount of destruction will always remain variable, depending upon the individual resistance. Heliotherapy and such are designed to raise the resistance. Surgery is applicable as an aid to the reparative process which heals the tuberculous lesion.

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ENTEROVESICAL FISTULA

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THE comparative rarity of fistulous communications between the bladder and some portion of the intestinal tract seems to justify a review of this condition. The part of the bowel most commonly affected is the terminal portion of the large intestine and the communication is generally found between it and the base or posterior vesical wall. This is doubtless due to the close proximity of the sigmoid, rectum, and bladder. Though a communication between the rectum and posterior wall of the bladder is the commonest site of enterovesical fistula, the condition is by no means confined to these two localities.

Pascal, in a very comprehensive survey of this subject, collected 195 cases, and in this series the communication extended from the bladder to the following: 113 to rectum, 42 to colon, 26 to ileum, 6 to cæcum, 1 to cæcum and appendix, 7 to appendix.

SEX

Cunningham, in a series of 342 cases, reports 75 per cent females and 25 per cent males.

ETIOLOGY

The condition may be subdivided into two classes: (a) traumatic and (b) non-traumatic. The traumatic variety may originate from a wound or accident, following which a vesico-intestinal fistula is developed; or it may arise as a result of surgical procedures. The non-traumatic variety may be subdivided into: (a) inflammatory, (b) tuberculous, (c) syphilitic, (d) actinomycotic, (e) echinococcal, (f) amœbic, and (g) malignant. The inflammatory may be due to: (a) abscess, (b) diverticulitis or diverticulum, (c) stone, (d) stricture, and (e) ulcer.

SYMPTOMS

The condition is accompanied by definite and distressing symptoms comprising: (a) gas per urethram, (b) fæces per urethram, and (c) urine per rectum. These are generally coupled with frequency and cystitis due to the continuous introduction of fæces and organisms from the bowel. The fistula is sometimes so constituted that only a one-way flow is obtained. As, for instance, in the case reported, while fæces passed from the sigmoid into the bladder, there seemed to be little evidence that urine passed from the bladder to the sigmoid, the bowel action always being normal, as also was the capacity of the bladder.

PATHOLOGY

The lesions most frequently giving rise to enterovesical fistula result from intestinal diseases. The primary cause of such a condition is not often found in the bladder and when originating from this site is generally the result of trauma, malignant growths or vesical tuberculosis.

Bryan, in a series of 42 cases, gives the following primary causes of the condition:

	Cases
Sigmoid diverticulitis	15
Probable sigmoid diverticulitis	6
Inflammation	4
Surgical trauma	3
Carcinoma of sigmoid	3
Carcinoma of bladder	2
Carcinoma (not specified)	2
Ovarian abscess	2
Amœbic sigmoiditis	1
Carcinoma or gumma of sigmoid	1
Tuberculosis	1
Stricture	1
Ulceration	1

DIAGNOSIS

When air and fæcal matter escape with the passage of urine there can be no doubt that a communication exists somewhere between the bladder and some portion of the intestinal tract.

Pneumaturia, however, may occur in other conditions: (a) after instrumentation of the bladder; (b) as a result of decomposing sugar in glycosuric conditions.

In cases in which urine will readily pass from the bladder into the bowel, the filling of the bladder with 12.5 per cent sodium iodide solution, or some other fluid impervious to X-rays followed by roentgenography, frequently gives very definite information. The best diagnostic evidence, however, is obtained when the site of the opening into the bladder can be determined and an opaque ureteral catheter passed along the tract of the fistula. In the case reported, this procedure was done, and after 60 cubic centimeters of a 12.5 per cent sodium iodide solution was injected through the ureteral catheter, a roentgenogram revealed a complete outline of the bowel into which the communication was opening. By this means it is possible to determine not only the extent but in addition the particular section of bowel into which the fistulous tract runs.

PROGNOSIS

Owing to the frequency and inconvenience caused by the condition, it is generally attended with anxiety, loss of sleep, and depression. These lead to loss of weight and general exhaustion. The prognosis, however, must necessarily depend on the primary cause of the fistula; if this happens to be a malignant growth the prognosis is naturally very unfavorable. If the primary cause is purely traumatic or inflammatory, the lesion is frequently amenable to surgical procedures and in some cases a spontaneous cure has resulted.

TREATMENT

The treatment is essentially surgical. Surgical procedures must depend on the nature of the primary pathological process causing the fistula and may be divided into curative and palliative.

In cases in which the fistula is the result of trauma or non-tuberculous inflammation, most gratifying results may be obtained, but if the condition is due to a malignant or tuberculous process, surgical procedures offer little hope of a cure.

The essential step is the obliteration of the fistulous tract, and for this purpose abdominal section in most cases offers the best approach. If the communication exists low down in the rectum, it may be reached by way of the perineum. Under these conditions it is generally possible only to separate the rectum from the bladder without closing the fistulous openings. In order to facilitate healing, it is necessary to keep the bowels from moving for some days, while at the same time the bladder should be drained by an indwelling catheter.

If the communication is higher than can be reached through the perineum, the abdomen is opened and after the adherent intestine is separated from the bladder, the fistulous openings in both bladder and intestine are closed, or, if necessary, resected together with any fistulous tract which may exist.

Colostomy as a palliative measure was formerly extensively employed. In the event of a communication being definitely demonstrated distal to the point selected for colostomy, this means of diverting the fæces from the bladder may be employed. Spontaneous closure under these conditions has been recorded but the procedure is now almost confined to hopeless cases.

Suprapubic cystotomy is another palliative measure which is seldom used except when the condition is a result of advanced tuberculosis or malignancy.

The non-operative treatment consists of measures likely to improve the general condition of the patient and minimize discomfort. In advanced tuberculosis or malignant disease, this is all that can be done.

The diet should be regulated so that, without any impairment of health, there should be a minimum of residue. Bladder irrigations with the introduction of antiseptics are generally of value in all types of cases.

The following typical example of this condition recently came under our care:

Mrs. M. B., age 51, married, admitted to hospital November 11, 1924. Patient has been ailing for last 6 months. She complains of passing wind with the urine, together with a considerable amount of sediment. She has no pain, no frequency, and no hæmaturia. The menopause occurred 5 years ago. Her appetite is good, and the bowels are normal and regular.

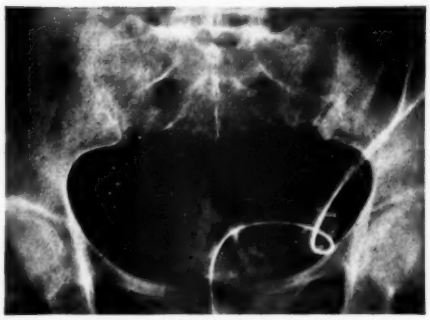

Fig. 1. Plain roentgenogram showing opaque catheters passing through the fistulous opening in the bladder into the sigmoid and from thence up the descending colon.

Fig. 2. Roentgenogram following the introduction of 60 cubic centimeters, 12.5 per cent solution of sodium iodide through the ureteral catheters. The bladder, sigmoid, descending colon, and transverse colon are all outlined. The opaque catheter can be made out in the fistulous tract between the bladder and sigmoid.

She complained of attacks of abdominal pain 8 to 10 years previously which were suggestive of appendiceal origin and on one occasion she was ill for 3 weeks with "inflammation of the bowels." Physical examination was negative. The urine (not centrifuged) showed pus, 25 to 30 (H.D.); occasional red blood cell (H.D.); epithelial cells, 1 to 2 (H. D.); organisms, rods; casts, none (H.D.); crystals, oxalates; albumin, none; sugar, none.

Cystoscopy, November 19, 1924, under cocaine anæsthesia, showed in the bladder walls clumps of mucopus adhering to the mucosa at various points. There was early trabeculation with early cellule formation. The interureteric ridge was elevated with ureteral orifices difficult to locate. Both ureters were catheterized to pelves without obstruction. Specimens were collected. Plain X-rays were negative. Bilateral pyelograms showed no abnormality of pelves. Kidney urines were negative.

Sigmoidoscopic examination failed to demonstrate any communication with the bladder.

November 4, 1925, cystoscopy showed about half an inch behind the right ureteral orifice a small opening into which two opaque ureteral catheters were passed without difficulty. Plain X-rays were taken with catheters in position (Fig. 1). Sixty cubic centimeters of sodium iodide solution (12.5 per cent) were injected through the catheters and an exposure made. Immediately following the introduction of the iodide, the patient had an urgent desire to relieve the bowel and passed a watery motion.

The X-ray revealed the catheters coiled up in the large bowel. The iodide completely outlined the bowel in the vicinity (Fig. 2).

On November 12, 1925 (open ether), through a medium hypogastric incision, a dense mass of adhesions between the small intestine, sigmoid, and bladder were exposed and separated by scissor dissection. Communication was found to exist between the sigmoid and bladder. The opening in the sigmoid was invaginated and reinforced by two appendices epiploicæ. Adherent loops of ileum one to the other were then separated and the raw surfaces peritonealized. The tip of the appendix was then separated from the adhesions and appendectomy done. The abdomen was explored. The wound was closed in layers with a rubber tissue drain, to the bottom of Douglas' pouch.

Findings. On separating the adhesions in the pelvis, we found that there were three parts involved, i.e., bladder, sigmoid, and two coils of terminal ileum about 6 inches from the cæcum, together with another coil of ileum from higher up. The hole in the sigmoid was obliterated by invagination as was the one in the bladder. When this was done, on following up the adhesions of the terminal ileum, it was found that the tip of the appendix was adherent to the cæcum between the bladder and the sigmoid and also to the smaller intestine. This must have been due to a ruptured appendix followed by abscess and communication between bowel and bladder.

Patient made an uninterrupted recovery.

July 6, 1926. Symptoms completely cured. The urine still contains some motile rods; no pus or sediment.

GRADES OF MALIGNANCY IN PRIMARY CARCINOMA OF THE GALL BLADDER[1]

By ISAAC MERVYN WEBBER, M.D., Rochester, Minnesota
Fellow in Surgery, The Mayo Foundation

FROM January, 1907, to January, 1924, operation was performed in fifty-two cases of primary carcinoma of the gall bladder in the Mayo Clinic. In thirty of these the pathological specimens and the history of the complete postoperative course were available for study. Twenty-seven of the lesions were adenocarcinoma, and three, squamous cell epithelioma. Irrespective of type, such carcinomata originate either in the surface epithelium of the gall bladder or in the deep epithelium of a gland. As a result of metaplasia, both adenocarcinoma and squamous cell epithelioma may exist in the same gall bladder or even in the same tubule. The two types of cell may be present in equal numbers or either may predominate. The lower tubule in Figure 1 shows metaplasia at an apparently early stage. The regenerative cells have produced squamous epithelium on the right and columnar or secreting epithelium on the left.

Clinically, the diagnosis of primary carcinoma of the gall bladder is exceedingly difficult. When it is encountered unexpectedly at operation, the extent of the excision must be based on the possibility of effecting a cure, or of appreciably prolonging the patient's life. In the absence of insuperable technical difficulties and demonstrable metastasis, it would seem that the determination of the grade of malignancy of the tumor would aid the surgeon to decide whether or not to attempt radical removal of the growth.

In 1915, Broders introduced the method of estimating the relative malignancy of squamous cell epitheliomata by grading, or expressing on a scale of 1 to 4, the amount of differentiated or mature epithelium in a microscopic section of the tumor. This method has particularly helped the surgeon to decide on the kind of treatment to be instituted and to determine the prognosis. In 1923, the same principle was applied successfully by Martzloff to the study of squamous cell epithelioma of the cervix uteri. In 1925 Greenough showed the utility of grading carcinoma of the breast.

In applying Broders' principle of grading to adenocarcinoma of the gall bladder, one must study the extent to which the cells acquire the structure of the normal columnar cell and the degree to which they acquire tubular arrangement. In squamous cell epithelioma, the degree to which the cells morphologically approach the normal squamous cell must be noted, as well as the extent to which they acquire the orderly arrangement of the cells of normal squamous epithelium. In either variety of tumor the rate of cell proliferation should be estimated, as MacCarty has pointed out, from the number and character of the mitotic figures, the irregularities in cell structure, and the staining characteristics of the cell.

In the less differentiated, or more malignant tumors, the cells show evidence of more active growth, and few of them reach the adult form, while in the more differentiated, or less malignant tumors, the cells are growing less actively and a larger percentage of them reach the mature form.

Under favorable conditions, the regenerative epithelial cells of the gall bladder may produce either glandular or squamous epithelium with malignant characteristics. Therefore, in the grading of carcinoma of the gall bladder, metaplastic epithelium must be recognized and the degree of its differentiation noted.

TABLE I.—GRADE OF MALIGNANCY IN RELATION TO LONGEVITY AFTER CHOLECYSTECTOMY

Grade	1	2	3	4
With malignancy	2	12	8	8
Recovering after operation	1	11	6	8
Shortest postoperative life (months)	16	2	2	0.5
Longest postoperative life (months)*	16	92.3	7.5	13
Average postoperative life (months)	16	36.5	4.2	5.2

*Two patients are living.

[1]Abridgment of thesis subm tted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, March, 1926.

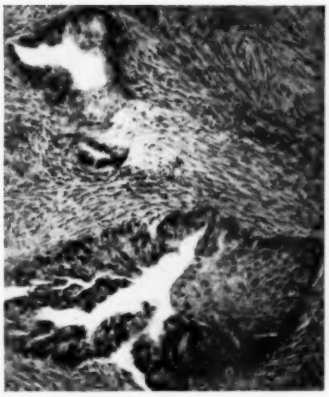

Fig. 1. Squamous cell epithelioma, Grade 3 (Case 13).

Fig. 2. Papillary adenocarcinoma, Grade 1 (Case 2).

Fig. 3. Adenocarcinoma, Grade 2 (Case 14).

The amount of fibrosis, hyalinization, and lymphocytic infiltration in the tumor was not considered in the present study.

Carcinoma of the gall bladder is Grade 1, when the epithelial cells showing differentiation constitute three-fourths or more of the total epithelium; Grade 2, when the epithelial cells showing differentiation constitute from one-half to three-fourths of the total epithelium; Grade 3, when the epithelial cells showing differentiation constitute from one-fourth to one-half of the total epithelium; and Grade 4, when the epithelial cells showing differentiation constitute one-fourth or less of the total epithelium.

Of the thirty cases in the present series, the malignancy was Grade 1 in two cases; Grade 2 in twelve, Grade 3 in eight, and Grade 4 in eight (Figs. 2 to 7).

Definite differences both in the clinical and operative findings, and in the prognosis can be noted when the fourteen cases graded 1 and 2 (Group A) are contrasted with the sixteen cases graded 3 and 4 (Group B). Palpable tumors were present in two cases in Group A, and in twelve in Group B. Extension or metastasis to other organs was present in four cases in Group A, and in fifteen in Group B. Excluding four patients who died before leaving the hospital (two in each group), the

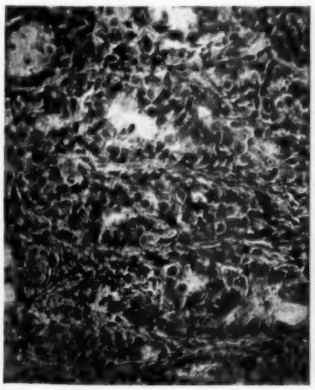

Fig. 4. Adenocarcinoma, Grade 3 (Case 16).

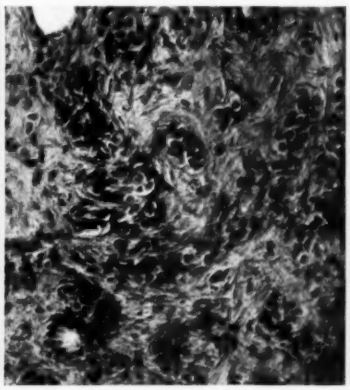

Fig. 5. Adenocarcinoma, Grade 4 (Case 23).

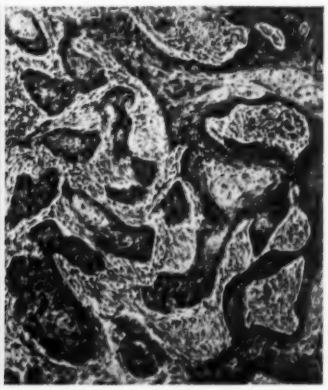

Fig. 6. Squamous cell epithelioma, Grade 2 (Case 9).

TABLE II.—THIRTY CASES OF PRIMARY CARCINOMA OF THE GALL BLADDER

Case	Sex, age	Abstract of history	Character of pain	Icterus on examination	Loss of weight, pounds	Palpable tumor	Diagnosis of gall stones	Stones found at operation	Extension of carcinoma	Duration of life after operation, months
		CASES OF MALIGNANCY, GRADE 1								
1	F 62	Attacks of pain in right upper abdomen, right costal margin tenderness and icterus lasting 3 or 4 days; duration 30 years	Almost continuous for 2 weeks prior to examination	o	10	o	+	+	o	16[1]
2	F 66	Lump in right upper abdomen for 4 or 5 years. A little painful and tender for 3 months prior to examination	Not stated	o	o	+	o[2]	+	Deep lymph nodes	o
		CASES OF MALIGNANCY, GRADE 2								
3	M 56	Spells of pain for 7 years in epigastrium, and left hypochondrium. In attack rolls on floor until morphine relieves	Severe, griping, to back	o	30	o	+	+	o	92.5
4	F 55	Attacks for 25 years of sudden epigastric pain running through back. Never jaundiced. Attacks last 3 hours.	Sudden, severe, to back	o	o[3]	o	+	+	o	88
5	F 52	Attacks of pain in right hypochondrium for 15 years. Residual soreness for 4 or 5 days	Sharp, severe	o	o	o	+	+	o	79[4]
6	M 60	Attacks for 5 years, griping pain in upper abdomen and back. Almost continuous pain during last 10 days	Aching pain daily	o	o[3]	o	+	+	o[5]	45.5
7	F 52	Spells of pain in right hypochondrium running to right scapula; recovers in 24 hours. Last attack 5 months ago. Jaundiced since	Sharp, embarrasses inspiration	+	o[3]	o	+	+	o	44.5
8	F 63	Yearly attacks of pain below right costal margin for 6 years. Jaundiced, clay-colored stools, gassy indigestion	Severe, crampy	o	o	o	+	+	o	13[4]
9	M 55	In last 3 years many spells of upper abdominal pain for 3 days. Jaundice. Frequent attacks in last 3 months	Colic-like	o	25	o	+	o	o	12
10	M 63	Pyrosis and anorexia for 4 months. Attacks of pain in right epigastrium for 11 years; jaundice followed spells	Severe, colicky, always radiates toward appendix	o	36	o	+	o	o	11
11	F 45	Spells of epigastric pain with jaundice for 7 to 10 days; 6 years' duration	Severe, to right scapula	o	o	o	+	+	Lymph nodes	7.5
12	F 53	Several attacks in last 3 years of epigastric pain and vomiting; malaise since last spell 3 weeks before admission	Very intense	o	o	o	+	+	o	6.5
13	M 65	Aching pain upper abdomen and back almost constant for 3 weeks. First attack of epigastric colic 18 months before admission	Discomfort; dull ache	o	12	+	+	+	Lymph nodes, pancreas	2
14	F 55	Pain beneath right costal margin, at short intervals for 2 months. First attack 20 years before admission	Not recorded	o	13	o	+	o	Liver, lymph nodes	o

[1] Partial cholecystectomy. [2] Diagnosed Riedel's lobe of liver. [3] Weight not recorded. [4] Patient living. [5] Recurrence in stump of cystic duct, exploration 3 years after operation.

TABLE II.—(Continued)

Case	Sex, age	Abstract of history	Character of pain	Icterus on examination	Loss of weight, pounds	Palpable tumor	Diagnosis of gall stones	Stones found at operation	Extension of carcinoma	Duration of life after operation, months
			CASES OF MALIGNANCY, GRADE 3							
15	M 55	Constant pain in right epigastrium for 2 months; no previous symptoms	Constant ache, to back	o	25	+	o	+	Liver	7.5
16	F 39	Attacks of hot flashes; bloating and tenderness of abdomen; backache 2 months	Not recorded	o	16	+[6]	o[7]	+	Ovary	5.5
17	M 51	Almost daily pain in right hypochondrium for 3 months. No digestive complaint	Severe at times	o	22	o	+	+	Liver	4
18	M 63	Spells of upper abdominal colic for 8 years. Jaundice with pain 8 months	Severity gradually increasing	+	20	+	+	+	Lymph nodes	3.5
19	M 63	Insidious onset of cachexia and icterus, 3 months' duration	No pain	+	26	+	+	+	Common duct[8]	3
20	F 50	Attacks of epigastric pain, occasionally with jaundice for 7 years	Severe, to back	o	o	o	o	+	Lymph nodes	2
21	F 64	Onset 6 months before admission with cachexia; pain in right costal margin for last 5 weeks	Mild	+	+	o	+	+	Liver	o
22	F 63	Attacks of epigastric pain for 26 years; jaundice since last spell 5 weeks before admission	Colicky, to back	+	23	o	+	+	Liver	o
			CASES OF MALIGNANCY, GRADE 4							
23	F 59	Attacks of pain in left hypochondrium; pain radiates to interscapular region. First attack 6 months before admission. No jaundice	Dull, aching	o	8	o	+	+	o	13
24	F 58	Spells of epigastric pain radiating to right shoulder for 9 months. Residual tenderness	Sharp, severe	o	8	+	+	+	Liver[9]	10.5
25	F 51	Dyspepsia. Almost daily discomfort left hypochondrium for 6 months	Not recorded	o	+	+	o[10]	+	Liver[10]	6
26	F 61	Seven months before admission began to lose weight, strength, and appetite. Never any pain or epigastric tenderness	No pain	o	40	+	o[11]	+	Liver, duodenum	4.5
27	F 59	Attacks of pain under right costal margin for 22 years. Almost constant ache for last 5 months	Variable in intensity	o	30	+	+	+	Liver	4.5
28	F 75	Dyspepsia, belching, vomiting; most distress 4 hours after meals; solid food aggravates; duration 5 months	Epigastric distress	o	13	+	o[12]	+	Liver, omentum, duodenum	2
29	F 62	One year before admission first noted fatigue, and malaise; almost daily discomfort or pain in epigastrium for 2 months	Discomfort	o	9	+	+	+	Liver	1
30	F 49	Right upper abdominal pain many years. Dyspepsia for 3 years. Jaundice with one attack	Severe, radiating to back	o	o	o	+	+	Liver	0.5

[6] Pelvic tumor. [7] Clinically diagnosed fibroids with ovarian cyst. [8] Section of duct removed with tumor. [9] Affected part of liver excised. [10] Clinically diagnosed tumor of liver. [11] Clinically diagnosed as probable abscess of liver. [12] Clinically diagnosed duodenal ulcer.

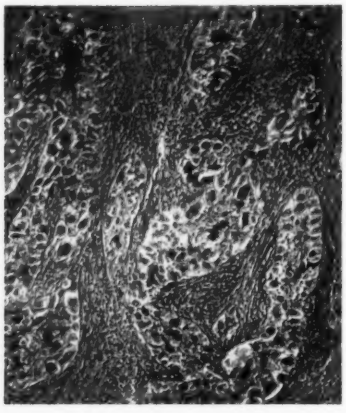

Fig. 7. Squamous cell epithelioma, Grade 4 (Case 26).

average postoperative length of life was 34 months for the patients in Group A, and 4.8 months for the patients in Group B.

Detailed data on the clinical, postoperative, and pathological findings in the 30 cases of primary carcinoma of the gall bladder included in the present study are presented in Tables I and II.

The presence of jaundice, extensive involvement of the liver, peritoneal grafting, ascites, and metastasis to the deep lymphatics have been considered contra-indications to radical operation for cancer of the gall bladder. Moreover, when a biopsy shows carcinoma of Grade 3 or 4, radical operation seems inadvisable, especially in view of the end-results obtained in the present series.

SUMMARY

The grade of malignancy in 30 cases of primary carcinoma of the gall bladder, treated by cholecystectomy, was studied to determine the existence of a relation between the length of life after operation and the grade of malignancy in the tumor removed. Twelve patients with carcinoma graded 2 or lower, lived an average of 2 years and 10 months. Fourteen patients with carcinoma graded 3 or higher, lived an average of only 4.8 months. Two patients with carcinoma graded 2 are living; one has remained in good health 6 years and 7 months, and the other in fair health 1 year and 1 month. Of twelve tumors graded 2 or lower, four were found at operation associated with gross or microscopic evidence of extension or metastasis. Of fourteen tumors graded 3 or higher, thirteen were found at operation to be associated with similar evidence of extension or metastasis.

In this group of cases the determination of the grade of malignancy through a study of the cell differentiation in a microscopic section of the tumor appeared to be a definite aid in estimating both the likelihood of metastasis and the relative length of the life of the patient after operation.

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LYMPHATIC INVOLVEMENT IN CASES OF CARCINOMA OF THE PYLORIC END OF THE STOMACH[1]

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Fellow in Surgery, The Mayo Foundation

A STUDY was made of 100 cases of carcinoma of the pyloric end of the stomach with involvement of the perigastric lymph nodes in which a portion of the stomach, including the growth, had been resected at the Mayo Clinic. There was no evidence of metastasis to more distant lymph nodes or adjacent organs. The resected neoplasm with the affected perigastric lymph nodes, as well as the case records, was studied in each case.

The cases of carcinoma of the stomach which are treated surgically may be divided into two groups: those without metastasis and those with metastasis. In the cases of the first group the results of surgical treatment were more gratifying. When metastasis was present the results were sometimes discouraging. The cases in which there was metastasis should be subdivided into two groups, the one, with metastasis to the perigastric regional lymph nodes and the other with metastasis to more distant lymph nodes or adjacent organs. Hence the cases presented here lie between those without metastasis, that are definitely operable, and those with metastasis to more distant lymph nodes or adjacent organs, which are either inoperable or only treatable by palliative measures.

Lengemann studied the regional lymph nodes which were removed with specimens of carcinoma of the stomach in the clinic of Mikulicz. He found that the coronary lymph nodes were diseased in 50 per cent of the cases; the nodes along the greater curvature in 37 per cent and the retropyloric nodes in 60 per cent. Forty-two per cent of the 302 nodes which he found were involved. Renner, in the same clinic, studied the lymphatic involvement in gastric carcinoma in 15 cases at necropsy. He found 50 per cent of 78 nodes of the subpyloric group involved. Cuneo studied carcinomatous stomachs from necropsy cases and after resection. He did not confine his studies to the lymph nodes alone, but included also the lymphatic system in the wall of the stomach by means of a modification of Genota's method of injecting the lymph spaces and vessels. He found that the nodes of the lesser curvature were affected in 87 per cent of the cases examined, and those of the greater curvature in 66 per cent. He has seen only the retropyloric group involved in 2 cases. He believes that a marked tendency is shown toward invasion of the lymph nodes of the lesser curvature. MacCarty and Blackford studied 200 specimens which had been resected or excised from the stomach in cases of carcinoma at the Mayo Clinic. Each specimen was studied immediately after its removal and again in fixed section. Their study included three groups of cases: those with no involvement of lymph nodes, those in which some of the nodes were involved and those in which all nodes were involved. The nodes were charted on diagrams; this plan has been used in the present study. In the cases in which nodes were involved, they found 1,062 nodes; 57.6 per cent of these were affected. They also showed that the size of a lymph node is no criterion of the presence or absence of carcinoma.

TECHNIQUE

All the specimens examined in the present study had been fixed in 10 per cent formalin. The size, type, and situation of the growth were noted. The site and relative size of all of the lymph nodes that could be found with each specimen were noted and recorded on diagrams. One half of each node was numbered, frozen, cut, and stained with hæmatoxylin and eosin. These sections were then examined microscopically and the findings recorded on their respective diagrams (Figs. 1 to 8).[2] Owing to the great number of nodes,

[2] The diagrams have been chosen from a group of 100 to illustrate some of the more interesting dissections.

[1] Abridgment of Thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, 1925.

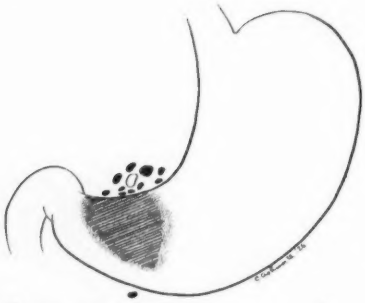

Fig. 1.

Fig. 2.

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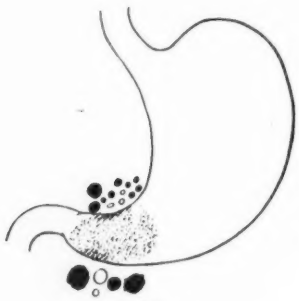

Fig. 4.

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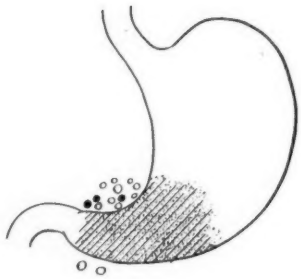

Fig. 6.

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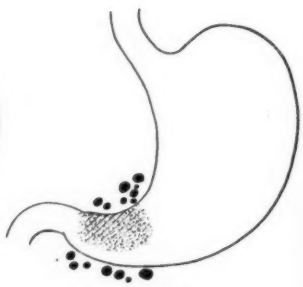


Fig. 8.

Fig. 1. The patient was a man aged 34. Symptoms had commenced 3 years before. The growth was of the ulcerative type and measured 8 by 5 centimeters. The operation performed was a Pólya.

Fig. 2. The patient was a man aged 70. Symptoms had commenced 6 months before. The growth was a carcinoma of the linitis type and measured 12 by 10 centimeters. The operation performed was a Pólya.

Fig. 3. The patient was a woman aged 31. Symptoms had commenced 6½ months before. The growth was a carcinoma of the linitis type and measured 14 by 10 centimeters. The operation performed was a Billroth II.

Fig. 4. The patient was a man aged 64. The symptoms had commenced 3 years before. The growth was of the fungoid type and measured 7 by 5 centimeters. The operation performed was a Billroth II.

Fig. 5. The patient was a man aged 62. Symptoms had commenced 4 weeks before. The carcinoma was of the ulcerative type and measured 4 by 3 centimeters. The operation performed was a Pólya.

Fig. 6. The patient was a man aged 63. Symptoms had commenced 4 months before. The carcinoma was of the fungoid type and annular. It measured 7 centimeters in diameter. The operation performed was a Pólya.

Fig. 7. The patient was a woman aged 47. Symptoms had commenced 3 years before. The carcinoma was of the fungoid type and measured 4 by 3 centimeters. The operation performed was a Pólya.

Fig. 8. The patient was a man aged 45. Symptoms had commenced 18 months before. The carcinoma was of the ulcerative type and measured 7 by 5 centimeters. The operation performed was a Billroth II.

serial sections were not made of those that are recorded as not involved. The nodes which were found to be affected were charted on the diagrams in solid black. Those which were not involved were charted in outline only. In some specimens the carcinomatous tissue had extended beyond the capsule of the lymph nodes; this was indicated by an irregular rough outline. The growths were then drawn in on the diagrams, diagonal lines representing the extension of the growth on the anterior wall of the stomach and stippling the extension of the growth on the posterior wall of the stomach.

RESULTS

In the 100 specimens examined, 824 lymph nodes were found. Eighty-five per cent of these were found to be carcinomatous. It was impossible to learn definitely which nodes were the first to become affected. However, those situated closest to the entrance of the coronary vessels on the lesser curvature and those closest to the pylorus on the greater curvature were found to be involved most consistently. It is not at all impossible that the findings of Jamieson and Dobson, that some of the collecting trunks of the lower end of the pylorus slip by the lower coronary group of nodes to terminate in the nodes situated near the falx coronaria, may explain the consistency of the involvement of the nodes nearest the point of entrance of the coronary artery. The nodes on the lesser curvature were affected in 91 per cent, those on the greater curvature in 69 per cent, and those on both curvatures in 60 per cent. These figures correspond to the findings of Cuneo.

The size of the nodes seemed to bear no definite relation to their involvement. In 12 specimens the largest nodes found were not affected, whereas smaller ones were. In 38 specimens nodes were found which were not affected but were considerably larger than some in the same specimen which were affected. In the 38 specimens, the growth was found to be ulcerative in 27 and of the fungoid type in 11. This is in accord with the observations of MacCarty and Blackford.

It is generally believed that the carcinoma cells invade the lymph nodes by a process of embolism, a few cells having been broken off from the primary growth and been carried to the lymph nodes along the lymphatic vessels. Billroth, Bozzolo, MacCarty and Blackford, Rindfleisch, Orth, Zehnder, Petrick, and Cuneo have all shown that carcinoma cells are found in the peripheral sinuses early in lymphatic involvement. This is explained by the anatomical structure of a lymph node in that the afferent lymphatic vessels enter the node at the cortex and form a network of peripheral sinuses surrounding the follicles. Figure 9 shows early involvement of a lymph node with carcinoma cells in the peripheral sinuses extending toward the medullary portion of the nodes between the follicles. It may be noted that the carcinoma cells do not extend into the follicles, which is in accord with Cuneo's observation that the lymphatic capillaries do not pierce the follicles but pass around them. Figures 10 and 11 show more advanced involvement of a lymph node.

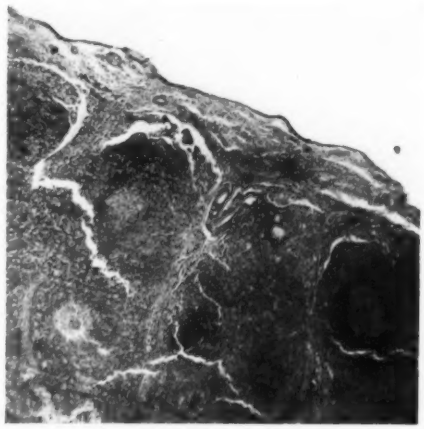
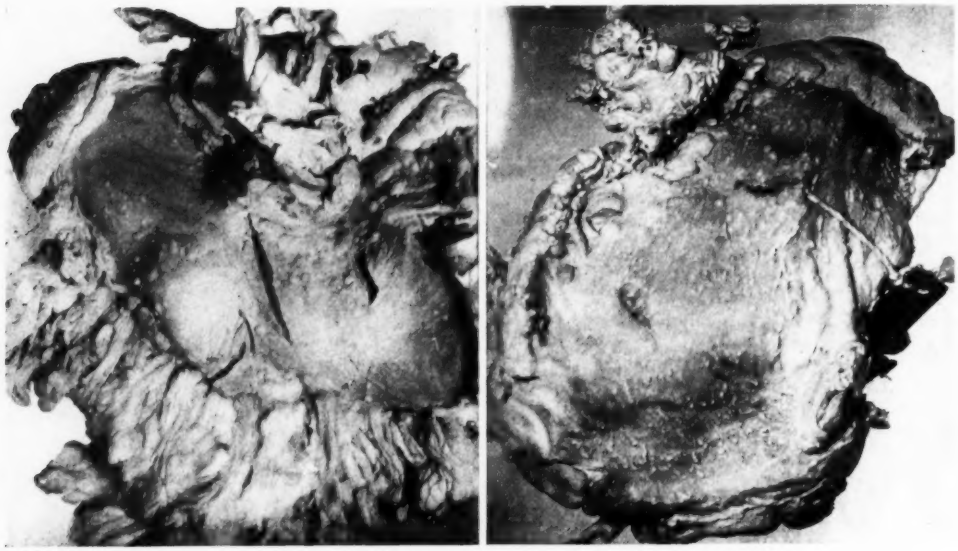


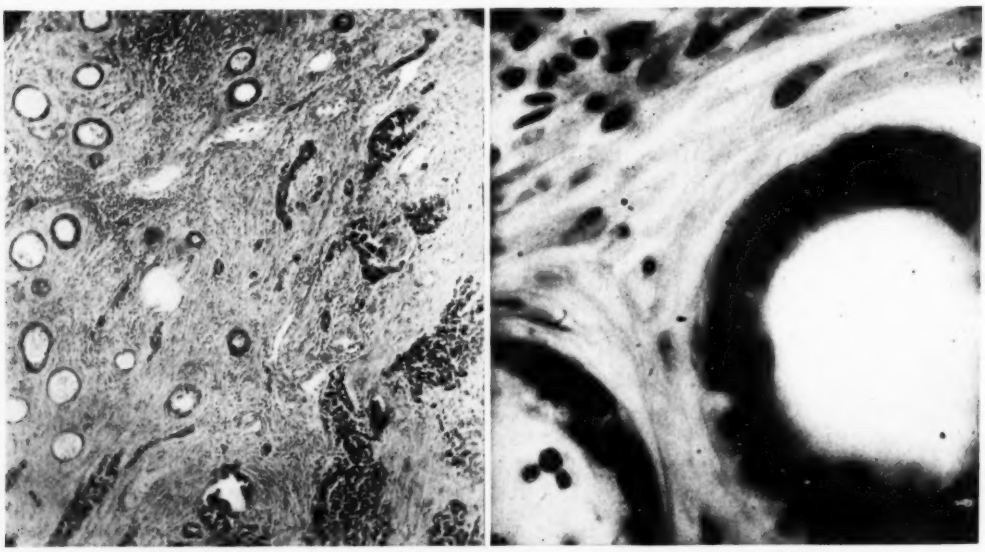
Fig. 9. Early carcinomatous involvement of a lymph node with infiltration in the peripheral sinuses.

The lymphatic vessels of the gastric wall form a subserous network before they unite to form the collecting trunks, which lead to the regional lymph nodes. When these vessels become involved they show up in the fresh tissue as whitish streaks and minute nodules. Figures 12 and 13 show two specimens which illustrate involvement of the subserous network of vessels.



Figs. 10 and 11. Advanced carcinomatous involvement of a lymph node.

The growths were classified as to type into four groups: ulcerative carcinoma, fungoid carcinoma, diffuse scirrhous carcinoma of the linitis plastica type, and a small group of carcinomatous ulcers. Fifty-six per cent of the growths were of the ulcerative type, 35 per cent fungoid, 4 per cent of the linitis type, and 5 per cent carcinomatous ulcers.



Figs. 12 and 13. Involvement of the subserous network; Figure 12, high power; Figure 13, oil immersion.

A distinction was drawn between the large ulcerating growth and the small ulcer which had undergone malignant change.

The situation of each growth was noted. Fifty-nine per cent were found on the lesser curvature, 34 per cent were annular and situated just above the pylorus, 4 per cent were on the posterior wall and 3 per cent on the greater curvature. This would indicate that carcinoma of the stomach almost always occurs on the lesser curvature and quite rarely on the greater curvature. The situation of the growth did not necessarily determine the exact site of lymphatic involvement. There were 8 specimens in which the lesion was on the lesser curvature and the nodes of the greater curvature showed relatively greater involvement; there were 7 specimens, in which the growth was situated on the lesser curvature, and there was equal involvement of the lymph nodes on both curvatures. In these specimens the number of nodes found on each curvature was taken into consideration as there were other cases in which more nodes were affected on the greater curvature, but not relatively more, since many more nodes were found on the greater than on the lesser curvature when the specimen was examined. These instances seem to show the importance of removing all the lymph nodes possible on both curvatures of the portion resected.

The largest growth which was examined measured 14 by 11 centimeters, the smallest growth measured 2 by 1 centimeter. In spite of the difference in the size of these two specimens, the smaller one showed involvement of all of the lymph nodes which were found with the specimen, whereas with the larger only 5 nodes were affected of 15 found. There were other similar instances. This again coincides with the findings of MacCarty and Blackford, that small growths or ulcerations may show complete involvement of the lymph nodes, whereas many of the larger growths do not. It is evident, therefore, that the size of the lesion is no guide to the condition of the lymphatics.

It was found that the life expectancy was definitely diminished when the glands of the greater curvature were involved.

CONCLUSIONS

1. The lymph nodes in closest proximity to the primary lesion are not necessarily those to be affected.
2. The nodes nearest the entrance of the coronary vessels and the pylorus on the greater curvature were found to be affected most consistently.
3. The size of the lymph node bears no definite relation to its involvement.
4. The size of the growth bears no relation to the number of lymph nodes involved.

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CHRONIC RHINOPHARYNGEAL DISEASE[1]

By BURT R. SHURLY, M.D., F.A.C.S., Detroit, Michigan

A CONSIDERATION or discussion of chronic rhinopharyngeal disease must be limited necessarily to one of its scientific phases under the various classifications, so voluminously outlined in our special literature, namely nasal obstruction. It is not my purpose to burden you with a paper involving highly specialized surgical technique, but rather to discuss some of the practical problems we meet in a long and constant daily contact with the various manifestations of chronic nose and throat disease.

In the school of experience we lay aside the ultraradical or ultraconservative methods of treatment for those of tried value. While the success of our results must largely depend upon diagnosis, operative skill and technique, and after care, too much attention can hardly be given to the psychological phase of our subject.

The diagnosis of all chronic rhinopharyngeal disease from the standpoint of the patient is either catarrh, tonsillitis, chronic cold, or, among the more intelligent, sinus trouble. A vastly increasing number of people in these days select their specialist upon a self-satisfied classification of their disease. It would seem to me, therefore, of considerable importance that in a scientific determination of our own successful diagnosis and treatment, an analysis of our patient's mental attitude should be given a more searching study. It is not infrequent to find imaginary or hysterical states greatly accentuated in our special field. As the number of referred cases decreases with the higher education of the masses who select their own specialists, the danger of overlooking the essential etiology increases and the interrelationship of ophthalmology and otolaryngology and internal medicine becomes more and more important.

If our specialty is to meet successfully the problems of chronic rhinolaryngeal disease, we must broaden our interest and knowledge to include borderline problems. Pathological processes have never held to strictly arbitrary lines. Underneath our problems we find the ever-operating laws of immunity. The virulence of the micro-organism and the resistance to infection often determine our results. With the laws of immunity we must constantly study the rôle of the endocrines and the supply of vitamines. The research laboratory is solving biochemical problems with the prophecy of modifying and eliminating some of the present day principles and practices of nose and throat surgery.

The relationship of the eye to the nose has been recognized for many years. The contiguity of structure, the venous route, and the lymphatics make the relationship interdependent. The important interrelationship of nasal disease, anatomical anomalies, and sinus infection have been most forcibly demonstrated by the studies of Loeb, Ouidi, Stucky, DeSchienitz, and others. Neoretinitis, papillitis, choked disk, optic atrophy, and exophthalmos, together with systemic infection passed over as neurasthenia, rheumatism of low grade, and septicæmia require a careful investigation for suppuration, and pressure in the sphenoidal cells or the ethmoidal labyrinth. While these old facts are well known the pathology is often overlooked. Pressure against the antral or septal walls may be relieved by removal of the offending middle turbinate.

Where these elementary surgical principles and a standardized choice of technique are thoroughly understood and applied, the relief of chronic rhinopharyngeal disease must ultimately depend upon deeper research study that will deal with the prophylactic measures that afford better immunity and cell growth in the individual. The rapid transportation of septic or chemical material through the network of the lymphatics to the cerebrospinal system can scarcely be realized until we perform the experiment of Cushing and inject 10 grains of urotropin into the rectum. In 1½ to 3 minutes, spinal and ventricular punctures will contain this chemical substance. Infection must then be considered and measured

[1]Read before the Clinical Congress of the American College of Surgeons at Montreal, October, 1926.

not alone in its local manifestations but as a continuous and constant systemic process.

It is only necessary to observe the demography of the goiter patient to realize the close and rapid interrelationship of the local vasomotor mechanism of the nose and throat with that of the general system.

The remote effects of nasal obstruction on the respiratory organs and the body at large are best demonstrated by the experiments of Anderson at the Detroit College of Medicine. A series of 100 guinea pigs, rabbits, and dogs were subjected to partial or complete closure of the nostrils by the use of cotton or collodion or denuding the nasal surface and suturing while the animal was under ether. All pigs with complete stenosis died from 2 to 8 hours later with marked distention of the abdomen from swallowing air. The effect on pigs with one nostril closed was death in 2 hours to 9¾ days, although 2 lived 8 months. Rabbits with one nostril closed died on an average within 45 days. Those living the longest developed asthma and emphysema, infection, and acute dilatation of the heart. Puppies died in 60 days. Of 14 pups born of mothers with a ⅔ nasal obstruction, 11 died within 61 days. Older dogs developed the signs of scurvy with almost complete loss of hair and great wrinkling of the skin.

These experiments upon animals show the following facts:

1. Nasal obstruction leads to death or serious impairment of vitality.
2. It causes lowered resistance and predisposition to infection.
3. Local disease of the respiratory tract is induced.
4. Obstruction of the nostril leads to dilatation of the heart.
5. Changes in the skin and blood are most marked.
6. Symptoms resembling asthma and emphysema often occur with histological change.
7. Re-opening the occluded nostrils is followed by prompt disappearance of the symptoms.

These experimental proofs of the profound systemic and toxic effects of nasal stenosis are undoubtedly in direct relation to the toxic effect of the disturbed blood chemistry. We are well aware of the importance of intestinal toxæmia and its relation to the acute and chronic inflammations in the ear, nose, and throat, but the relation of disturbed lung chemistry and the air contained therein is a newer field that is not sufficiently appreciated. The exchange of oxygen and carbon dioxide, the elimination of excrementitious material, organic substances, and watery vapor is an elementary fundamental of physiology. The relation of the proper discharge of the 100 cubic inches or more of residual air, especially from the apices of the lung and its toxins to the problems of obstructed nasal respiration is a new chapter with faint elucidation. Digitalis, ergot, and quinine have a distinct physiological action according to the mechanism of cell selection. The toxins of residual air have a definite action on the cell, as demonstrated by Delos Parker at the Detroit College of Medicine. If the residual air is blown into a basin containing a solution of lime water and the same evaporated, a fine layer of snowy white crystals will remain. The chemical combination is redissolved in distilled water and injected in a series of varying strengths into a pigeon and a dog. An increasing disturbance of cell chemistry takes place with the selective action of the poison manifested particularly on the ectodermic tissues. The hair or feathers fall partially or completely as the toxæmia advances. The animal becomes bald. If costal breathing is accentuated in the dog by means of a corset, the hair is rapidly restored.

The effects of nasal obstruction may therefore be most remote and hidden in the blood chemistry. It is true that individuals with most complete nasal occlusion may go through life without apparent damage. We must appraise and value the necessity for surgical interference with the greatest care. The indications for a submucous resection of the nose or the removal of tonsils and adenoids, together with other obstructive lesions, have classical rules of application of definite value. The future may add other indications observed by findings in the blood chemistry and measured by laboratory methods. It is my belief that our good work does not end with the simple surgical procedure. It is taken for granted that all pathological tissue is removed,

although the percentage of remnants of such tissue is 1 to 5 per cent at least, especially if the LaForce adenotome alone is used for that operation.

Many children of the lymphoid type, those with lowered resistance to infection, those with cervical adenitis not relieved by operation for sinuses and nasal obstruction, those with recurring otitis media and so-called respiratory catarrh, will respond surprisingly to nature's remedy that all the tissues call for and is almost as plentiful as the air—namely, a simple household receipt made in the kitchen, the components plucked from the garden: 2 potatoes, 2 carrots, 2 beets, 2 tomatoes, and a bunch of celery squeezed through a meat press strained and placed in the refrigerator and served, a wine glass full, with salt and pepper and flavoring, with each meal.

This preparation of the salts of mother earth that belong in the blood has been used in my work for 30 years with great success, and the biochemist now tells us that this prescription contains a wealth of vitamines. Alternated with cod liver oil or red bone marrow, the genuine value of these foods is very great in postoperative otolaryngological surgery.

In our endeavor to relieve chronic rhinopharyngitis and establish standards of treatment, it is interesting to go underneath our strictly surgical procedure and remember that chronic hypertrophic rhinitis, for example, and like pathology is influenced in its development from the fact that man is now an artificial animal. Under the laws of conservation, why are the nasal passages with their great importance to the preservation of health so frequently marked by deformation and hypertrophies? Is it not true that many of our surgical problems are fundamentally present on account of etiological factors that are evolutionary and devolutionary through many generations and ages? The head of the Caucasian varies at the present time decidedly from that of centuries ago. The anthropologists tell us that the relative proportion of the face and calvarium has undergone slowly through the ages certain changes, until now the facial parts of our race are diminutive and compressed as compared with other parts of the body.

The fact of this change to artificiality is of course greatly reinforced by the relatively increased difficulty of parturition. It would seem logical to believe that prenatal as well as postnatal processes are at work in the increasing necessity for surgical work in the nasal passages. It has been stated that more than 80 per cent bear the mark of an asymmetrical or abnormal developmental condition in the upper respiratory regions. Under these laws and those of heredity, we are called on to meet a progressive change in respect to the osseous framework of the face. This departure from the aboriginal type furnishes an increasing tendency to the hypertrophies of early life.

Neglected sinus infection has for many years been a constant source of chronic rhinopharyngitis, but my experience on our examining board leads me to believe that the splendid instruction and excellent knowledge of our younger men will rapidly dispel any criticism along this line. The detection of sinus disease in infancy and childhood due to the investigation of Dean and others is rapidly diminishing the neglect of this etiological factor. Our modern laboratory methods are extremely efficient in uncovering the syphilitic taint as a factor. A better control of our nutritional problems in infancy is counteracting the lack of structural integrity that artificiality imposes.

As life advances pathological conditions should decrease, influenced by the wonderful discoveries in immunization against the exanthemata. It is also not surprising that these delicate mucous membranes with their highly vascular and neural supply and the limited space in which they operate and develop should be influenced by climatic change.

Since it is the function of the turbinate bodies to become vascular and swell in order to protect the lower air passages from very cold air by the radiation of heat to the incoming current of air and mechanically lining the lumen for the passage of the same, too much importance cannot be laid on the bad effects of exposure of the nasal passages to sudden extremes of cold, heat, and variations in moisture.

It is the common custom in our climate to subject this delicate mechanism to radical changes of dry heat at 80 degrees F. to 40 or

even below zero, thus straining the marvelous equalizing function of the vasomotor centers and destroying their necessary tone. These acts certainly produce chronic hypertrophic change, and frequently with attending infection. The artificial environment and mode of life of the modern Caucasian being taken into consideration, it is not difficult to understand the profound influence these changes exert upon the development of early pathological conditions or physical defects. The balance between the physiological and pathological state is destroyed, in spite of the maintenance of the powerful endocrine control over the vasomotor system.

While occupations and habits predispose to loss of vasomotor tone and to infection, we can scarcely hope to eradicate chronic rhinopharyngeal disease. The hope of amelioration lies in a brilliant scientific future when the Caucasian child will be reared in less artificiality with an opportunity to adjust his respiratory passages to natural climatic environment. The surgery for the relief of obstructive lesions will become more and more efficient and follow standardized rules of application.

It is my belief however that we are near the dawn of an understanding of the laws of immunity and metabolism that will revolutionize many present methods of procedure. The untold prophylactic value of toxin-antitoxin for diphtheria, antitoxin for scarlet fever, measles, and tetanus, and of typhoid inoculation is now well known.

Our hope lies in proper immunization, the maintenance of endocrine balance, the restoration of proper facial development by scientific feeding, vitamine supply, and outdoor life. Meanwhile, otolaryngological surgery will progressively maintain its usefulness.

SOME OTOLOGICAL PROBLEMS[1]

By E. H. CARY, M.D., F.A.C.S., Dallas, Texas

I WISH to approach some otological problems from the sociological and clinical aspects. Macleod Yearsley in 1925 stated that a survey of otological literature for that year gave greater promise of advance in knowledge of the ear than a review of the previous 25 years. He credits this advance to the effort made toward the prevention of deafness, which, of course, means as well the study of those diseases of the ear destructive to hearing.

I shall hope to develop the same thought in a thesis for this occasion.

If it is true that we have as many hard-of-hearing in this country as the available statistics indicate, there being over a million, then we are feebly, palliatively wet-nursing the great mass who have not yet lost their optimism and come to us for help. We are caring for the ones who come our way, honestly striving to relieve them; and in many ways we render valuable service. It is true we know our limitations; it is also true we too frequently speak of our limitations, thereby failing to serve when much could be done.

However, a more serious effort can be made to prevent the occurrence of the so frequent loss of hearing. You promptly ask, "How"? To answer this question in detail would be a repetition of much that you have had before you, therefore I will content myself by making suggestions regarding therapy.

It is generally believed that approximately 85 per cent of all deafness is due to middle ear involvement. Ninety per cent of these middle ear infections have their origin in inflammatory conditions of the nasopharynx with extension to the ear by way of the eustachian tube. If these two statements are approximately true, then it is quite evident that we have already gone far to prevent thousands from becoming deaf through having popularized the surgery of the nasopharynx as well as of the associated lymphoid tissues in the fauces.

No surgeon should leave untreated the continued inflammatory reactions which often remain after the removal of tonsils and adenoids. In such patients the definite nasal and sinus infections are the associated factors in the persistent inflammations of the middle ear which determine the final loss of hearing. These sinus infections are just as easily cured as the pharyngeal inflammations in the hands of trained and capable specialists.

This type of surgery properly performed has undoubtedly greatly lessened the number of the deaf.

It is also true that there has been an unnecessarily large amount of bad surgery performed by those more interested in other phases of the question than in the pathological and physiological points involved. On the whole, however, there has been an advance in service rendered and the general results can be commended. It remains for the profession to separate the good from the bad, and to use its knowledge to further prevent chronic middle ear disease and its resulting deafness.

Hays' very complete paper written in 1921, calling for measures which are needed for the prevention of deafness during early life, can be mentioned for your perusal, and I can avoid a repetition of similar ideas.

I particularly commend to you the educational phases of the problem of the prevention of deafness. Well directed, conservative propaganda which goes a step further than educating the parents, teachers, and physicians to those factors which give rise to deafness should certainly reach children in early school life through teaching them the facts concerning the functions of their special senses, the influence of consanguinity and heredity, prophylaxis, and relief measures. The facts should be presented to them in simple, but effective language.

There should be conducted in every school health examinations which would bring to light defects of the children and the potential

[1] Read before the Clinical Congress of the American College of Surgeons, Montreal, October, 1926.

possibilities as well. Routine examination of children's ears in school is just as important as investigation of their eyes. Preventive measures of far-reaching effect can be instituted at this stage of the child's life.

Health examinations as a routine for the young without regard to school, with the idea of keeping the child fit would be the means of training the future men and women to periodical inquiry as to their well being.

Curative measures to the limit of our capacity should go hand in hand with preventive measures and it should come to pass that the profession would profit in an effort to prevent disease with greater satisfaction to themselves.

In the *Archives of Oto-Laryngology*, Shambaugh et al. present "Statistical Studies of the Children in the Chicago Public Schools for the Deaf," which is one of the most complete studies made of a given number of children that I have had the pleasure of reading. They have data concerning about 290 cases that were thoroughly analyzed.

Taking statistics made elsewhere into consideration, I believe the information reasonably complete. The facts may be applied to over nineteen thousand children similarly situated in schools for the deaf in the United States. We must allow for the percentage variance in classification in the tabulation of congenital or acquired causes, which seem to have some relation to racial tendencies and national environment. Shambaugh states that of the 145 classified as acquired deafness, there was no history of middle ear inflammation in 85.

The difficulty of making a correct diagnosis in infants is quite obvious. As regards the ear, "diagnostic surmise" would better describe the conclusions of the usual attendants. Children in untold numbers have had otitis media and no one has known it until the discharge appeared. What of the cases in which the pressure was not enough to rupture the tympanic membrane? Could not this type of middle ear involvement in the acute infectious cases tabulated by Shambaugh be the cause of a larger number of cases of acquired deafness, in the 50 per cent of those children examined?

Apparently the thought of treatment of the totally deaf, as analyzed by Shambaugh, would be out of the question and education is the only feasible solution for their betterment. It would seem too that the tabulated causes of acquired deafness occurring in such young children from such a variety of infections could not have been foreseen or greatly influenced even if infection had been recognized at the time the labyrinth became involved.

However, it would have been interesting to study the middle ears of these infants in large numbers during the acute stage of the infection, with the thought in mind that the infant had been strong enough to resist the infectious disease, yet in the battle had unfortunately lost the hearing due to a labyrinthine involvement. With the foregoing in mind, can we account for the labyrinthitis by presuming that it was the result of a contiguous local infection? Such an infection might arise in the tympanic cavity, this cavity having been filled with an exudate not producing enough pressure to rupture the drum membrane, but to have developed a serous labyrinthitis, and probably adhesions. Such a general infection has been recognized and tabulated as causing approximately one-half of the deaf mutes in the country.

I cannot deny the remote possibility of a hæmatogenous infection as a cause of serous labyrinthitis, but it seems to me that a labyrinthitis is much more likely to result from the middle ear infection. The lymphatic drainage of the middle ear toward the retropharyngeal and parotid lymphatic glands can be upset with pressure, when from infection, seepage can occur into the internal ear due to blockage of channels below and direct extension into the labyrinth.

I am suggesting that a comprehensive study of those afflicted is not possible until the babies of the land are more uniformly treated by trained pediatricians whose judgment of an ear condition goes beyond the question of pain or a ruptured drum membrane. General practitioners and otologists have been unable to exert much influence, the first from lack of information, the otologist from lack of opportunity. The trained pedia-

trician who sees the sick baby establishes an early diagnosis after studying the tympanum. He then takes no chances regarding hidden exudates. They who believe a creamy white membrane hides an abundant toxic element can save a reasonable percentage of infants from deafmutism.

We are rapidly coming to a time—in many cities the time is already here—when the pediatrician can seriously discuss with us deafmutism and its prevention with the prospect that he will observe early signs of disease evidently insidious and hidden to a physician less well trained. By this means some cases of deafmutism acquired from infectious diseases, which are now considered unpreventable, might be prevented.

If the child is to be saved from this acquired affliction, he must be saved when the acute infection is present. No one believes there has been a suppurative labyrinthitis in these persons who have lost their hearing. It has evidently not gone beyond a serous labyrinthitis. Suppurative labyrinthitis is no doubt associated with cases that go to necropsy.

I question a history given by a member of the family at a late date to the effect that the child had pneumonia or any other infectious disease, "and there was no inflammation of the middle ear, but my child has been deaf ever since." The basis of reaction may be contiguous infection rather than circulation of toxins through the blood which finally affect a part of the body through accident or affinity. I appreciate the fact that this opinion may be the subject of argument. Basing your argument on the grounds of selective affinity, you may at once call my attention to the fact that in the infant there must be some relation between infection of the mastoid and the remote disturbances of the intestinal tract, with dehydration, fever, rapid loss of weight, leucocytosis, etc. In these children an autopsy study fails to show an intestinal lesion, and this fact suggests some unproved metabolic disturbance.

On the other hand I call your attention to the case in which there is a very large mastoid antrum, more or less filled with an inflammatory exudate but not quite sufficiently to produce necrosis, with frequently a tympanic but not sagging membrane; in which it is denied that this would pollute the milk and food of the infant from tubal leakage, infect the intestinal tract, and be followed by the complications just named. The otological basis of reaction in this case is so remote that we have only lately found through co-operation with the baby doctor that such a thing is possible. Our only danger now is that through their enthusiasm and lack of surgical judgment, an uninformed baby doctor and otologist will discredit the most interesting piece of work done in years. I have had occasion to observe this phase of the situation already.

I agree with Dr. Shambaugh in the following: With few exceptions the absence of vestibular responses in cases of acquired deafness mean the presence of total deafness; and conversely the presence of vestibular responses whether normal or subnormal suggests the likelihood of some remnant of function remaining in the cochlear mechanism, that is, some remnant of hearing. In congenital deafness vestibular responses are more often present than absent. In acquired deafness it is unusual to find any vestibular responses. In acquired partial deafness vestibular responses are more often present than absent. It is evident that malformations or congenital defects of any kind, if not obliterative, would leave areas for vestibular actions, whereas any inflammatory process great enough to destroy all of the hearing would usually destroy all vestibular responses, and *vice versa*.

My plea would be to make a greater effort to enlist the co-operation of the men who see these cases of infectious fevers.

Now, passing to the next great cause of deafmutism, we find that 50 per cent of deaf mutes are apparently born deaf, and are classified as congenital cases. Consanguinity and heredity would seem to affect the child as regards inherited tendencies. Consanguinity would seem to be highly operative in its influence when the individuals have similar blood, probably the same unusual type and subject to the same opsonic index as regards a given infection, and with similar

inherent tendencies. Any concurrent infection might affect the growth of certain cell arrangement in a manner which we find expressed in the loss or function of a given part.

It would seem a waste of time and words to argue that anyone can prevent congenital deafness. In the literature consanguinity and heredity are given as the two most important clinical factors connected with this unhappy state. It is not quite clear how many other influences affect congenital deafness. After malformations, consanguinity, and heredity, the next cause usually mentioned is syphilis. We know that syphilis in the mother may cause deafness in the child; the eighth nerve is often involved.

There are many other diseases of an infectious nature that probably produce malformations in the internal ear. Any malformations of the child can be most readily explained by the fact that the corrective influence of the placenta failed to protect the embryo from the infection of the mother; when the embryo had become infected the placenta failed to correct the slight damage; and this damage later showed itself as a malformation, possibly due to an injury to the embryonic cells while they were at work creating the internal auditory mechanism. Hence the prenatal care of mothers in the early stage of pregnancy is most essential.

It is conceivable that when the knowledge of obstetrics has advanced to the point where people have the wisdom to protect the environment of the embryo, it will come through a conviction that malformations arise from the limited infections from which the placenta fails to protect the cells of the embryo. The more severe infections destroy the fetus and sometimes the mother.

Mall with his successor Streeter, and their associates, under the Carnegie Institute, Department of Embryology, have examined many specimens of embryos, and many that are pathological. They find that of those in the first month of gestation, one-fifth are normal; in the second month, only one-half; while in the third and fourth months, eight-ninths are normal. They think that malformations or monstrosities in the newborn are the result of some localized anomaly which occurred in the early development, yet was not sufficient to cause death and abortion.

It is not difficult to suggest the plan which humanity might adopt to bring greater safety and a more perfect physical development, but human beings, as a whole, will not avail themselves of our advice, yet slowly the trend of protection and prevention is upward. For a long time—yet to come—there will be need for all the help which can be rendered to the deaf and it is interesting that at this time psychologists are contributing their aid, adding vibratory methods to broaden the education of those unfortunates. Papers of much interest have been written upon the compensations of the deaf and with Shakespeare we can say: "None can be called deformed but the unkind." However, for the majority of people deafness is a calamity. The loss to the nation and the individual from deafness and ear diseases is stupendous. It is claimed that nearly all deafness is preventable. To make progress in the prevention of deafness would be a great step forward and it cannot be done without the otologist's interest and leadership

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DISCUSSION

DR. J. M. WAUGH, Cleveland, Ohio: Doctor Cary deals with deafness prevention in a most interesting manner. That the subject is of tremendous economic and sociological importance to the individual afflicted as well as to the Nation is evidenced by the statistics submitted by the author, to the effect that in the United States alone more than one million people are "hard of hearing" and of these 15 per cent or 150,000 are deaf and dumb.

That 850,000 or 85 per cent of this number owe their disability to diseases of the middle ear is generally conceded. Fully 90 per cent of these middle ear conditions originate in acute inflammations of the nose, throat, and accessory nasal sinuses. Our specialty can be justly proud of its accomplishment in having popularized the tonsil and adenoid

operation, which will unquestionably have a most beneficial effect on the hearing of this coming generation. Progress has also been made in drawing the attention of the medical profession and the public to the importance of accessory nasal sinus inflammations as a frequent cause of middle ear inflammations in infants, children, and adults. Sinus disease education, first of the otolaryngologist himself and through him of the medical profession and the general public, is one of the important immediate tasks of organized otolaryngology, just as the tonsil and adenoid question was the problem of prime import 10 years ago.

Diet deficiency—especially vitamine A—as a cause of sinus disease has been demonstrated by Amy Daniels of the University of Iowa School of Medicine. She has fed mice into or out of sinus disease by decreasing or increasing this vitamine. The assumption, already fairly well established, is that humans react likewise. The otologist is thus furnished an additional means of deafness prevention.

Doctors George and Gladys Dick, of the MacCormack Institute for Infectious Diseases, have placed a new obligation on otolaryngologists. The Toxæmia of scarlet fever disappears with the use of their serum within 7 days. Thereafter the toxic symptoms are due to focal infections, almost always located in the ears or accessory nasal sinuses. The prompt recognition and treatment of these falls squarely on the shoulders of the oto-laryngologist. Prompt action on our part will eliminate scarlet fever, to a very large extent, as a cause of deafness.

The cause and prevention of otosclerosis is another matter which commands our attention and careful consideration. The Committee of the American Otological Society, of which Norval H. Pierce is chairman, fully equipped with funds for thorough investigation, should help to solve this old question that has puzzled otologists.

Deafness prevention, as Doctor Cary has so timely stated, can be greatly promoted by: (1) regard for consanguinity and heredity; (2) more frequent and earlier ear examination by otolaryngologists; and (3) pre-natal care.

I wish to emphasize the last two.

More frequent ear examination by otolaryngologists should be made in every obscure febrile disturbance in infants, children, and adults. Waiting for pain to point out the affected ear too frequently leads to extensive mastoid disease, and often, labyrinthine destruction. If the mastoid disease is bilateral, total deafness results with very defective or entire loss of speech as an inevitable consequence. The general practitioner and pediatrician should turn such cases over to the otologist early, and not after paracentesis or spontaneous drum rupture has occurred. The most dangerous acute conditions of the ear are those that are silent. The cases of mastoid disease caused by influenza and pneumonia during the late war emphasize this fact. Cases of the exanthemata in infants and children, especially those with extensive toxæmia, are known to be without subjective symptoms.

Routine physical examinations through school age and adult life with examinations of the ear, nose, and throat, conducted by otolaryngologists, will go far toward the prevention of chronic otitis media of the catarrhal form by instituting early and proper nasopharyngeal and rhinological hygiene. Many cases of nerve deafness might be prevented also by their early recognition. Our specialty's voice has scarcely been heard in the campaign that is spreading over the country to popularize periodical health examinations.

Prenatal care as a means of deafness prevention has received almost no attention whatsoever up to the reading of the present paper. Physicians have long recognized the importance of syphilis in its relation to the child *in utero*. Other diseases of the mother may be of equal consequence in the development of an ill-formed child. Ear defects may be as frequent as malformations of any other part of the body under these circumstances. Conversely, is it not reasonable to believe that a vigorous, healthy mother, safeguarded during pregnancy from infectious diseases of every kind by every means possible, nourished by food of proper combination and adequate amount, may be expected to bring forth a child perfectly formed and free from congenital defects of the ears as well as the rest of the body?

It is hoped that otolaryngologists will see the need of prenatal care and appreciate that the ear is as frequently subject to malformations as any other organ. Our influence should be given to the education of the general profession and of the public to this end.

CONDITIONS OF THE EYEBALL ARISING FROM RHINOPHARYNGEAL DISEASE[1]

By WILLIAM H. LUEDDE, M.D., F.A.C.S., St. Louis

THE literature concerning conditions of the eyeball arising from rhinopharyngeal disease has become so extensive that the recital of a catalog of titles and authors could easily absorb all the time available for this presentation. Evidently these complications are not unusual; however, from the first there has been a wide difference in published opinions about their relative frequency.

Thirty years ago in a standard ophthalmic textbook by Noyes (15), the only mention of any relation between the nasopharynx and eye, except conditions involving the nasal duct, referred to a physician who had accommodative asthenopia which seemed to be much aggravated by "nasal catarrh."

Zuckerkandl (1882) and Weichselbaum (1885) on the basis of pathological conditions and anatomical relations pointed to the possible connections between sphenoidal sinus inflammations and the orbito-ocular system. Berger and Tyrmann (1886) discussed the complex clinical manifestations. Among pioneer rhinologists Hajek (1904) commented on the infrequency of ocular symptoms. Among early ophthalmic writers Fuchs referred to the rarity of ocular disease of nasal origin and to the impossibility of a positive diagnosis during the life of the patient. Moreau (1905) reported that among 820 patients suffering from sphenoidal sinusitis not one showed ocular lesions. On the other hand de Lapersonne (1898) estimated that at least 5 per cent of sinus inflammation gave rise at some period to some ocular manifestation, and Berthemes (1900) stated that suppuration of the sphenoid was rather more often discovered by the oculist than by the rhinologist. Then came the convincing presentation of Onodi (1905) showing beyond question the relation of infection of the ethmoid and sphenoid to ocular disease.

The last three decades have greatly expanded our knowledge and experience in this field. So recent has been its development that the distinguished leaders who brought it about are our own teachers or colleagues. Civic pride and personal friendship compel me to name at least two of them, Greenfield Sluder and Hanau W. Loeb.

Conditions of the eyeball related to nasopharyngeal disease are naturally divided into two primary groups, external and internal. The latter group may be further divided into (a) disordered ocular functions without demonstrable organic changes; and (b) pathological changes in the ocular tissues.

It may not be possible to classify every case with absolute precision but some sort of an outline permits a better understanding of the relations between diseases of the nose, throat, and eyes than can be gained from a chaotic presentation of clinical experiences. No doubt we all agree with Rollet who writes that the special interest in this question lies in the interpretation of the cause of these phenomena ("l'intérêt de la question réside spécialement dans l'interprétation de la cause de ces phénomènes").

CONDITIONS OF THE EYEBALL RELATED TO DISORDERED OCULAR FUNCTIONS

The principal functions of the eyeball are retinal perception and focal adjustment. As causes for ocular disorders of purely functional type we may enumerate (1) retrobulbar pressure; (2) reflex nerve impulses; (3) vasomotor disturbance; and (4) toxins.

Retrobulbar pressure. The function of vision is lost or impaired if there is anything to interfere with proper transmission of retinal impressions to the brain via the optic nerve, etc. The common everyday experience of "a foot gone to sleep" shows us how simple pressure upon a sensory nerve may inhibit its function. The optic nerve passes through the short but narrow optic canal in most intimate anatomical relation to the post ethmoidal and sphenoidal sinuses. Hence, inflammations involving these sinuses may produce direct pressure upon the optic nerve through defects in the optic canal or by secondary swelling of the periosteum within the canal sufficient to suspend the function of seeing for a variable period. In these cases there need be no abnormal appearance of the ocular tissues either externally or on ophthalmoscopic inspection; just a foot that has "gone to sleep" appears natural in every way.

The first and most impressive example of the functional loss of vision caused by nasal sinus disease in my experience was encountered 20 years ago.

[1] Read before the Clinical Congress of the American College of Surgeons at Montreal, October 26, 1926.

A young man from Jefferson City, Missouri, arrived in St. Louis late one afternoon saying that he had suddenly lost his sight in both eyes that morning. After a few minutes the sight in one eye returned but the other remained impaired. It was reduced to recognition of hand movements at one meter. He stumbled and ran into things in walking about due to the sudden loss of binocular vision. He gave a history of persistent headaches for 2 weeks previously. Ophthalmoscopic examination showed no cause for the loss of sight. Rhinological examination by Dr. Sluder made within an hour showed acute general swelling of the nasal mucosa practically closing the meatus on the side of the affected eye. Attempts to reduce this swelling were continued throughout the night at St. Luke's Hospital. About 5 o'clock the following morning there was a copious discharge of pus and blood from the nose with prompt restoration of normal vision. Three days later a temporary obstruction to nasal drainage was revealed through a marked loss of vision in the same eye found in the routine daily visual test. After that there was an uneventful recovery.

The sudden onset and the immediate relief following appropriate nasal treatment without any demonstrable pathological change in the ocular tissues indicates that the disturbance of the function of vision was due to pressure upon the optic nerve. The absence of other signs of any functional disorder of the nervous system and the discovery of a definite pathological condition involving the postethmoidal and sphenoidal sinuses on the side of the affected eye dispose of the possibility that this might have been a hysterical manifestation.

Both the beginning and the subsidence of pressure upon the optic nerve may be gradual as shown by the following clinical examples.

Miss A. B., age 36, reported May 30, 1922, that the vision of her left eye had been cloudy at times during the previous week as though mucus covered the front of the eyeball. She had worn glasses for 3 years and at once consulted the oculist (Dr. M.) who had prescribed these glasses for her. He found no lesion in the left eye to account for the loss of vision and tried to persuade the patient that her eyesight in the affected eye was as good as ever. His suggestive therapeutics were an utter failure. Examination showed normal vison in the right eye but an inability to recognize even the largest test types at any distance with the left eye. Central vision in the left eye was reduced to an uncertain recognition of the direction of hand movements at one foot but she retained the ability to count fingers at one foot at the extreme temporal periphery of the field. Nasal examination on the same day by Dr. Greenfield Sluder revealed "a left sided sphenoid abscess." The sphenoidal suppuration in this case gave rise to little if any pain or subjective discomfort except the loss of vision.

Medical treatment and suction tried for 3 successive days only brought sight in the left eye to 2/150. Therefore, a radical sphenoidectomy was done by Dr. Sluder on the fourth day. One week later vision in the affected eye was improved to 16/75. At this time ophthalmoscopic examination suggested a possible slight œdema of the macula which soon disappeared. At the end of 2 weeks normal vision had been restored to the affected eye. A careful search for a central scotoma with the aid of the Bausch & Lomb stereocampimeter at this time failed to reveal any defect nor was there any increase in the normal blind spot. This patient has been kept under regular observation at longer intervals. Vision has remained normal in each eye and at no time has there been a departure from the normal ophthalmoscopic appearance of the optic nerves of either eye. Both onset and relief in this case proceeded in a more gradual and yet in an unmistakably characteristic manner. Incidentally this case teaches that no time should be wasted in "suggestion" for the restoration of vision even if there is no pathological change in the ocular fundus or media. The possibility of nasal sinus disease must first be eliminated.

In the next case the onset was even more insidious but recovery was very prompt. This case was rather unique in its uniform simultaneous bilateral loss of vision.

Celeste A., age 14, was examined January 28, 1924, on account of nearsightedness. With −2.0 spherical lens for each eye vision was equal to 20/15. These glasses were prescribed. One week later vision was found to be the same and the patient was entirely comfortable in her school work as well as in the general use of her eyes. Regular routine inspection of myopic school children at monthly intervals is always demanded until it is definite that there is no further increase in myopia. At the end of the first month it was noted that there was a slight loss of visual acuity. It was assumed that there was some increase in the myopia. Monocular atropinization was used for several weeks and careful limitation of the amount of near work provided. After another month it was apparent that vision in each eye had been reduced to 20/30 with the best correction by glasses that could be determined. Also the patient had several severe headaches. Ophthalmoscopic examination revealed nothing abnormal in either eye. A nasal examination was now advised. Dr. H. W. Loeb found a chronic ethmoiditis, some deflection of the septum and hypertrophic tonsils. After palliative nasal treatment vision was restored to 20/15 and headaches ceased, but after 4 days vision again fell to 20/30 and in 3 days more to 20/40 and 2 days later it was only 20/50 in each eye, with the best possible correcting lens. Tests failed to reveal any discrepancies in the patient's answers. Headaches, too, returned though they were not so severe as at first. The ophthalmoscopic appearance remained normal. At this time Dr. Loeb curetted the right ethmoidal cells and 4 days after this operation the sight of the right eye was restored to 20/20+ while the vision of the left eye was still 20/40 minus. Operation was therefore advised on the left side. It was not done until 2 weeks after the right ethmoid had been evacuated. Dr. Loeb reported the finding of two small polypi and a very tiny cell (almost obliterated) in the left ethmoid. Following the evacuation of the left ethmoid vision was 20/12 right and 20/20+ left. One week later vision was 20/12 for each eye and no change of the original glasses was indicated. In fact vision was now better with them than when they were first prescribed. This excellent vision has remained for the last 2 years.

In this case the loss of vision was the same in each eye. The onset was extremely insidious but there was a steady and persistent loss which threatened serious consequences. No pathological changes in eyes were present to explain the loss, but a definite diagnosis could be made of

the nasal disease. Proper nasal treatment was followed by a striking improvement in eyesight, even before the surgical elimination of the bilateral sinus disease brought complete permanent restoration of function.

We have, therefore, the possibility of a functional impairment of eyesight due to postethmoidal or sphenoidal disease without organic pathological changes. The condition is more frequently one sided but may be bilateral. A localized perineuritis of that portion of the optic nerve lying within the bony canal has been suggested by Berger as an explanation. In that event there is almost certain to be some organic, demonstrable pathological change in the optic nerve. It seems more reasonable to assume that these functional disorders of vision are merely secondary to pressure exerted on the optic nerve.

Reflex nerve impulses; vasomotor disturbance; and toxins. It is often difficult to distinguish between the three other causes of disordered ocular functions. These causes must therefore be discussed all together.

Among the disorders of ocular function of reflex nasopharyngeal origin, the following conditions have been named: photophobia, conjunctival hyperæmia, blepharospasm, lacrymation, general or local ocular pain, muscæ volitantes, scintillating scotoma, accommodative asthenopia, painful accommodation, changes in the visual field, keratoconjunctivitis, neuroparalytic keratitis, mydriasis or myosis, and variations in intraocular pressure. According to accumulated experience it seems more and more improbable that all of these disturbances ordinarily originate from simple nasopharyngeal nerve reflexes. Ziem pointed out that sensory or sensual disorders of the eye could not be truly reflex. According to MacLeod a single reflex acting independently of the rest of the nervous system does not really occur. An afferent impulse spreads so as to involve a large variety of motor or excitosecretory neurons, each of which may however be excited through other afferent fibers arriving either from other receptors or from higher nerve centers. To those inclined to doubt the possibility of a reflex from the nose to the eye Berger proposed the simple test of pulling the fine hairs in either nostril and noting how quickly lacrymation begins on the same side. Berger insisted that neuralgic affections of the trigeminus of nasal or dental origin may give rise to trophic disturbances in its ophthalmic branch shown by herpes corneæ, etc. Panas and Parinaud accepted reflex action only as an explanation for transient functional ocular disorder.

Ziem believed that congestion of collateral circulation afforded the proper explanation for many of these cases. Pechin suggested that congestion causes a *locus minoris resistentiæ* permitting a latent infection to localize itself.

Probably Kuhnt is nearer the truth in believing that toxins due to diseases of the nasopharynx play the largest part. The toxins of focal dental infections are today the commonly accepted explanation of what Berger considered reflex irritation of dental origin. The paralyzing action of diphtheria toxin upon accommodation is a well known phenomenon. It has happened several times in my experience that severe sore throat has produced a similar after effect upon accommodation. In a number of such cases no likelihood of a recent Klebs-Loeffler infection could be discovered by clinical and bacteriological investigation. In one of them, an army officer located at Jefferson Barracks where there had been several cases of diphtheria, a previous latent diphtheritic infection was strongly suspected but in no way supported by facts. It is admitted that influenza and severe sore throat are sometimes followed by weakened ocular accommodation and that it very probably is due to toxins originating in the nasopharynx rather than to a nerve reflex.

Investigations of Sluder, Berger, and others demonstrate that intra-ocular pressure may be influenced by nasal conditions. In patients under my observation, intra-ocular tension in simple chronic glaucoma has been reduced temporarily and the pain of acute glaucoma has been markedly lessened by local anæsthesia of Meckel's ganglion. These effects were too uncertain and transient to be incorporated in the routine treatment of the disease. However, they suggest the possibility of far-reaching ocular effects from nasal treatment. It was assumed that this effect might reach the eye by the way of a branch from Meckel's ganglion to the ciliary ganglion controlling intra-ocular secretion. But recent opinion (Whitnall) seems to be conclusive that the ciliary ganglion has no influence on intra-ocular secretion of fluids or tension.

It is more probable, therefore, that this intraocular effect is due to vasomotor reaction through the sympathetic which sends fibers to the sphenopalatine (Meckel's) and ciliary ganglia. Vasomotor disturbances causing an increased or decreased localized sensitivity of the retina are a possible explanation for muscæ volitantes and scintillating scotoma. It must be remembered that these phenomena are also associated with ocular fatigue and are by no means due exclusively to reflexes or vasomotor reactions from the

nasopharynx. Vasodilatation or vasoconstriction account for mydriasis or myosis which has been observed. Neuropathic or nutritive disturbances may be produced similarly in the eyeball through the influence of the sympathetic ramifications.

Another criticism was that these functional ocular disorders might be hysterical. This must be answered by a search for other clinical signs of hysteria, by study of the visual fields, and by the cure of the ocular disorder on elimination of the nasal irritation.

Painful accommodation is sometimes explained by the cooperation of the superior obliques in convergence. This action causes traction on the pulley of the oblique muscle and may give rise to local pain if there is frontal sinusitis.

Even though the measurable effect of each is an uncertain quantity it is well to remember in connection with functional ocular disorders that conditions in the nasopharynx may give rise to reflexes which are carried to the floor of the fourth ventricle over the trigeminus and returned to the eye through the distribution of the third, fourth, sixth, or seventh nerves and that sensations of pain originating in other branches of the fifth may be referred to its ophthalmic branch. Fuchs calls attention to the fact that the ophthalmic branch of the trigeminus "runs through the cavernous sinus to the superior orbital fissure and in this part of its course lies close to the lateral surface of the body of the sphenoid." He gives this as "the reason why it may react under the form of occasional neuralgias to an inflammation of the mucous membrane of the sphenoid sinus."

The great variety of functional ocular manifestations of diversified etiology related to the nasopharynx requires the closest possible cooperation between the rhinologist and the ophthalmologist in order that a diagnosis may be made and the proper treatment administered.

CONDITIONS OF THE EYEBALL RELATED TO PATHOLOGICAL CHANGES IN OCULAR TISSUES

No ocular structure is immune to pathological changes arising from the nasopharynx. There is no reason why any of the tissues of the eyeball should be exempt. With the possible exception of the conjunctiva, their vascular and lymphatic supplies are identical. Hence we may have various forms of superficial or interstitial keratitis, iritis, cyclitis, circumscribed or disseminated choroiditis, hyalitis, cataract, retinitis including retinal periarteritis, phlebitis or thrombosis, papillitis, optic neuritis or neuroretinitis, retrobulbar neuritis, toxic optic atrophy, etc., in any or all of which etiological investigation may lead to the nasopharynx as the cause of the condition. Conditions in the nasopharynx seem also to have more than a casual relation to the three great bugbears of ophthalmology—glaucoma, retinal detachment, and sympathetic ophthalmia. The extent or importance of the latter associations will not be known until the obscure etiological problems pertaining to these diseases have been solved.

There is no special type in these inflammations in the various tissues of the eyeball that positively identifies them as being due to diseases in the nasopharynx. Clinical familiarity with certain types may lead to a strong suspicion that this or that case seen for the first time is of rhinopharyngeal origin, but the actual diagnosis can only be made by exclusion. Various unsuccessful attempts have been made to designate certain variations in the appearance of the optic disc or defects in the visual field as exclusive diagnostic signs of rhinopharyngeal disease. There are no reliable short cuts to a complete diagnosis which would determine the etiological factors. The whole patient must be studied.

Pathological ocular lesions may be so minute as to be found only after the most persistent and searching examination calling for all the various instrumental aids that have been devised to assist in ophthalmic diagnosis. On the other hand the pathological process involving the eyeball may be so extensive and severe that total destruction or disorganization follows immediately. Fortunately, such annihilation is rare. These violent types are caused by actual bacterial invasion either by contiguity or by metastasis. The milder types which may however be very dangerous to eyesight are more often due to toxins. Ocular infection by contiguity from the nasopharynx may reach the eyeball by extension through the orbit or more superficially by the continuity of the nasal mucosa through the nasal duct and lacrymal sac.

The pathogenic organisms most often present in conjunctivitis or dacryocystitis of nasopharyngeal origin are the pneumococcus or some variety of staphylococcus. Whether the infection has been conveyed to the eye by contiguity, that is by an extension upward through the nasal duct; or transferred to the eye indirectly by fingers or handkerchiefs, often remains unanswered. Obstruction of the lower end of the nasal duct is a frequent primary factor in the etiology of dacryocystitis but infection of the sac probably is brought about more often after drainage ceases by bacteria carried into the stagnant secretions from the conjunctival sac. The most satisfactory results from the treatment of the lacrymal sac

conditions are attained by the perfect co-operation of the rhinological and ophthalmic surgeon. The appropriate treatment in any given case must be determined by those in charge. Two fundamental considerations must be the guide—cleanliness and the establishment of drainage.

Destruction of the eyeball may follow by contiguity after infection of the orbital tissues originating in the paranasal sinuses. According to Kuhnt, Panas, and Rollet, the usual clinical sequence is corneal ulceration, perforation, and panophthalmitis rather than a direct transfer through the scleral barrier into the posterior segment of the eyeball.

Effective treatment of orbital infection usually prevents complications within the eyeball. The course of inflammations of the ocular tissues caused by actual bacterial invasion coming from the nasopharynx by contiguity or metastasis depends on the virulence of the invading organisms. Subsequent treatment of the primary disease in the nasopharynx may then be of little benefit.

Putting out the original fire in a general conflagration may be of little help, nevertheless it is usually the right thing to do. Where only smoke and sparks are being blown about, putting out the primary blaze will prevent damage to adjoining property. Applied to pathological ocular conditions arising from rhinopharyngeal disease, this means the prompt enucleation of infected tonsils or the effective drainage for nasal sinuses by surgical intervention if required unless age or serious constitutional disease creates too great a risk.

"Smoke and sparks" are represented by the toxins or attenuated bacteria carried to the ocular tissues by the blood stream and lymph currents from the nasopharynx.

To understand why infections of the nose and throat are not invariably transferred to the ocular tissues we must study the channels of communication. The possibility that bacteria can be conveyed to the ocular tissues by blood-vessels has been demonstrated clinically by multiple uveal abscesses in pyæmia and experimentally, with special reference to tubercle bacilli, by the researches of Stock and Finoff. Proving this possibility does not necessarily establish the probability that it is the usual manner in which bacteria are brought to the ocular tissues. The presence of tubercle bacilli in the blood stream is likely to produce the general miliary type of tuberculous disease in animal experiments as well as in the afflicted human being. Many ocular conditions arising from rhinopharyngeal diseases are purely local and do not appear as manifestations of a general constitutional malady.

It is justifiable, therefore, to assume that often the transfer is made through lymphatic communications. Bacterial invasion by way of lymphatics is usually held up and localized by lymph nodes or glands. There are no orbital lymph nodes or glands to separate the lymph channels of the nasopharynx from the orbito-ocular system. Lymphatic communication throughout the nasopharynx is free and ample. Whitnall states: "The lymphatics of the orbital cavity are imperfectly known in man. As elsewhere in the body, the system no doubt consists of spaces which are perivascular in position. Definite lymph vessels can be demonstrated in the eyelids, conjunctiva, and lacrymal gland, but as regards the orbit itself, although Schwalbe and Parsons describe Tenon's capsule as enclosing a definite lymph space lined with endothelium and continuous with a supravaginal space around the optic nerve, and others have considered the interlobular spaces of the orbital fat to be likewise lymph channels, such intervals do not show any special structural development, though like similar spaces elsewhere in the body they may contain plasma from the blood vessels.

"Leber who in 1876 denied that the perichoroidal space of the eyeball communicated with the space in Tenon's capsule is supported by Charpy and Hesser, who state that the latter is neither a true serous nor a formed lymph cavity. While the manner of entrance of lymph into the eyeball still remains the subject of an unfinished controversy there is general agreement that the lymph passes out of the eye round the anterior ciliary and vorticose veins and the central vein of the retina, and eventually into the jugular lymph trunks. The lymph vessels of the orbit are supposed to pass through the inferior orbital fissure to the internal maxillary nodes, and thence to those of the upper deep cervical groups, and communications may also exist between the orbital system and that of the nasal cavity or accompany vessels passing through the superior orbital fissure; they have not been demonstrated in man."

Careful and persistent study of the problem of lymphatic communications between intra-ocular and extra-ocular tissues by reliable and competent investigators has produced contradictory results. Some find channels of communication freely open; others, equally trustworthy, find them closed. May we not on the basis of general clinical experience conclude that in some patients lymphatic communications are open so that rhinopharyngeal diseases unmistakably do become a cause of ocular complications? On the other hand these communicating channels are often so ob-

structed that severe rhinopharyngeal disease and even orbital cellulitis may be present without any intra-ocular complications whatever. To account for the diversity of clinical and experimental observations has been the most baffling phase of our problem. Since physiological and histological research has not produced positive information, we are warranted in adopting an explanation that is in accord with our clinical observances. Permeability of the eyeball for lymphatics need not be the same in two individuals, nor in the two eyes of the same individual, nor in the same eye at all times. Naturally then the results of tests will not be identical.

The ciliary processes secrete the bulk of the intra-ocular fluid (or lymph). Angelucci and Parsons have emphasized the close histological resemblance between the ciliary processes and the glomeruli of the kidney. Simple filtration combined with selective activity on the part of the epithelium covering the ciliary processes is evident on chemical examination of intra-ocular lymph. It differs somewhat from the general body lymph. Agglutinins and precipitins are allowed to pass freely into the aqueous humor while other substances such as hæmolysins are not allowed to pass into it. Agglutinins and precipitins are sometimes considered as a part of the defensive mechanism of the body. This selective secretion on the part of the ciliary processes may be a factor in the protection of the eyeball against bacteria or toxins coming from the nasopharynx or elsewhere. In regard to their action Wells states "possibly agglutination favors phagocytosis and lessens dissemination of the infecting organisms but it is not generally considered that the influence on the course of infection is great. It may be looked on as an incident in the infection rather than as a definite method of resistance." However the proposition merits further study.

Another factor in the defense of the eye against rhinopharyngeal disease may be found in the anatomical distribution of blood vessels and lymph spaces. The anterior and posterior segments of the eyeball are almost entirely independent of each other in this respect. The anterior lymph spaces include the interstitial tissue spaces of the cornea (and sclera), the anterior chamber, the posterior chamber, and the perilenticular spaces (spatia zonularia). The posterior group includes the hyaloid canal of the vitreous (canal of Cloquet), the perichoroidal space, and the intravaginal lymph spaces of the optic nerve, that is, the subdural and subarachnoidal spaces of the sheath of the optic nerve. Parsons estimates that not more than $^1/_{50}$ of the lymph secreted by the ciliary processes passes backward into the vitreous. That these arrangements tend to favor the localization of diseases of the eyeball anteriorly or posteriorly is a well known clinical fact.

The perivascular lymphatics of the nasopharynx, orbit, and eyeball, probably play the most important rôle of all in the transfer of bacteria and toxins to the eyeball. Numerous anastomoses between the blood vessels of the nasal mucosa and the branches of the ophthalmic artery and vein furnish possible avenues of approach to the ocular tissues. The presence of perivascular lymphatics in the retina, choroid, and iris, as noted by Parsons and Angelucci provides access to intra-ocular tissues. The perivascular lymph stream probably moves rather slowly and in the direction of the blood stream of the vessel which it accompanies. This partially accounts for the relatively greater frequency with which diseases of the nasopharynx give rise to ocular complications rather than to intracranial lesions. The ophthalmic artery and its perivascular lymph current pass forward with the optic nerve in its intimate anatomical relations to the sphenoidal and postethmoidal sinus.

Another variable factor in the transmission of bacteria or toxins or both from the nasopharynx requiring further study is the rate of flow of perivascular lymph current. Obviously, when the flow is accelerated, bacteria and so forth may reach the ocular tissues earlier, if permeability permits, and hence be more likely to produce lesions. The same is true of toxins. It would be interesting, if time permitted, to support what has been said about variability in the lymphatic transmission to the eye by clinical reports.

Peters states that the entire intra-ocular fluid exchange is normally slow and the details are still the subject of intense discussion. In certain ocular tissues such as those of the cornea and macula, the flow of lymph is certain to be retarded on account of the absence of blood vessels. It is at these points that rhinopharyngeal disease very often gives rise to disease manifestations.

Neither a positive diagnosis of syphilis nor of tuberculosis should permit us to overlook the possibility of rhinopharyngeal diseases in relation to ocular conditions. The slide here shown is made from a microphotograph of a section of an eye enucleated after acute purulent uveitis brought on by metastasis from an acute empyema of the postethmoid and sphenoid on the same side. This patient had contracted syphilis 4 years previously. He had had constant treatment and

showed no active manifestations of the disease. In at least 1 case of apparent syphilitic optic nerve atrophy I have seen astounding improvement after nasal operation for the drainage of the postethmoid and sphenoid. In others, the progress of the atrophy has been arrested. As they had active antiluetic treatment both before and after the nasal intervention there may be some doubt as to the degree of benefit resulting from the nasal treatment.

With reference to ocular tuberculosis some clinical observations indicate direct transmission of the tubercle bacillus or its toxin from the nasopharynx to the eyeball. In a number of cases intra-ocular lesions giving positive focal reactions after a test injection of tuberculin have healed following the eradication of disease in the nasopharynx.

Unmistakable benefit has been noted in the course of sympathetic ophthalmia and in the treatment of incipient retinal detachment after enucleation of infected tonsils. Such cases stimulate further study of etiological relations.

The possibility of ocular inflammation due to rhinopharyngeal disease being conceded, it becomes axiomatic that an ophthalmic surgeon must attempt to eliminate such diseases in securing the most favorable conditions for any intra-ocular operation. In a recent case an iridectomy and an Elliot trephining had been done on both eyes for relief from bilateral glaucoma without success. Enucleation of infected tonsils and the elimination of some dental infection was demanded. After this preliminary preparation a subsequent iridectomy was followed by an eminently satisfactory and apparently lasting result.

In closing it becomes necessary to sound a word of warning against the danger of that overenthusiasm which tries to find in rhinopharyngeal disease sufficient cause for all obscure ocular conditions without completing the diagnostic study by a careful search for any other etiological factor. Years ago the importance of rhinopharyngeal disease was sometimes overlooked as is painfully evident in the following case history.

Mrs. R. N. J., age 17½ years, first examined December 18, 1911, presents a double optic atrophy. Examination by the local eye, ear, nose and throat specialist of her city was confined entirely to the eyes which showed bilateral optic neuritis. She was referred to a distinguished surgeon of the middle west. After neurological consultation and confirmation of the ocular condition by another ophthalmologist, a bilateral temporal decompression was done as there were no localizing symptoms for an intracranial lesion. It was assumed that there could be no other cause for the ophthalmoscopic picture. It was hoped that cranial decompression would stop the headaches and prevent further loss of vision. This hope was not realized for vision failed rapidly and the headaches continued unchanged. Both for relief from the latter and in the hope that some sight might be restored the patient had been brought to St. Louis. A nasal examination not having been made nor even suggested throughout the course of the case, it was urgently recommended. Dr. Sluder discovered a double sphenoidal empyema, the treatment of which gave immediate permanent relief from the headaches and a perceptible improvement in light perception and projection. The advanced optic atrophy precluded further improvement of vision. A subsequent neurological examination by Dr. Unterberg of St. Louis failed to show any sign of an intracranial lesion, nor has there been any evidence of it in the past 15 years.

The failure to consider a rhinological etiology was a mistake but can be justified by excellent authority. Bilateral optic neuritis due to nasal sinus disease had been considered impossible. Rollet referring to optic nerve disease of nasal origin states: "la lésion du nerf optique quand elle emprunte l'aspect ophtalmoscopique d'une papillite, simple ou œdémateuse, est toujours unilatérale."

I have encountered only one other case of bilateral optic neuritis, typical choked discs, due to nasal sinusitis.

Mrs. G. L., white, age 41, February 24, 1925, was given a careful general examination at the St. Louis University Hospital (St. Mary's), and showed no sign of intracranial disease. Complete recovery of vision and comfort followed bilateral drainage of the postethmoidal and sphenoidal sinuses by Dr. H. W. Loeb.

Both of these patients are alive although one of them is blind. But the other side of the picture is more serious. In the last 2 years I have seen 2 cases of bilateral optic neuritis in both of which neurological and ophthalmoscopic examinations were not made until it was too late to save life. Both were taken to Class A hospitals but these important examinations were put off as mere details because the physicians in charge of these cases were satisfied to rest with the discovery of nasal sinusitis. Months of time were thus wasted. In the first case the brain literally exploded and a fragment spurted across the operating room when cranial decompression was at last attempted after operation on the sphenoidal sinuses had proved to be an utter failure. The last patient died from respiratory paralysis 3 days after the ophthalmoscopic examination and before the neurological examination was completed. Both cases showed other signs of intracranial disease.

Therefore, lest we forget—let us repeat that there is no short cut to a diagnosis, the whole patient must be studied.

DISCUSSION

DR. FREDERICK TOOKE, Montreal: I esteem it a personal as well as a professional privilege to open the discussion

on this most interesting and valuable paper contributed by my friend, Doctor Luedde.

Illustrative cases have been supplied early in this presentation; but as one gets beyond the pressure symptoms with their correlated ocular manifestations, one is often left to wonder how our essayist himself would place the various ocular symptoms of photophobia, conjunctival hyperæmia, blepharospasm, lacrymation, general or local ocular pain, muscæ volitantes, scintillating scotoma, accommodative asthenopia, painful accommodation, changes in the visual field, keratoconjunctivitis, neuroparalytic keratitis, mydriasis or myosis, and variations in intraocular pressure as applied to his original classification of reflex nerve impulses, vasomotor disturbance, and toxins. Cases illustrating these various types of ocular phenomena would have been of distinct value particularly regarding the rôle of toxins or the question of autogenous infections.

Doctor Luedde has modestly eluded this possibly unreasonable suggestion on my part early in his paper when he states: "It may not be possible to classify every case with absolute precision; but some sort of an outline permits a better understanding of the relations between diseases of the nose, the throat, and the eyes than can be gained by a chaotic presentation of clinical experience." Such an outline Doctor Luedde has assuredly given us; but I challenge his statement that his clinical experience is chaotic. The illustrative cases cited in his paper are examples of scientific precision and accuracy.

With the negative relationship between the eye and the accessory nasal sinuses as stated by such authorities as Hajek, Fuchs, and Moreau about 1905, it is interesting to note the absolute difference of opinion of de Lapersonne who some years earlier stated that at least 5 per cent of sinus inflammations give rise at some period to some ocular manifestation. Again, Syndackos writing only a few years later in the *Klinische Monatsblaetter fuer Augenheilkunde,* clearly showed that the cause of from 7 to 10 per cent of headaches, for which an oculist is consulted, is to be found in the accessory nasal sinuses. One would not, as an oculist, avoid or elude the statement that has been made that a definite diagnosis of an obscure condition in the sphenoid or in the posterior ethmoid cells has to be determined very largely if not altogether by the ophthalmologist. To quote a case in point:

M. A., a young woman of good health and habits consulted me for the relief of headache and pain behind the right eye. The history of onset and subsequent course were simple enough in that the condition was monocular, had no association with application to close work, being quite severe at night, and that it followed a severe cold in the head. The patient was referred to the Royal Victoria Hospital and a standard physical examination undertaken. At this time there was a slight perineural swelling, vision was reduced to counting fingers at 2 meters, and a central scotoma was definitely positive. In the rhinological department, particular attention and interest was taken in the case, but in spite of X-ray photographs and other methods of investigation they had to state that clinical manifestations in the case did not warrant operation. There was no polypoidal formation, and no evidence of pus. With the persistence of pain, the maintained diminution of vision, and with a perineuritis that had now reached a full 3 diopters of actual swelling, and in spite of negative findings in the nose, Doctor Hamilton White consented with our cooperation clinically to make an exploratory dissection. I need not say that this was most skillfully done. What was found was an intense swelling of the posterior ethmoid cells with very little space in the posterior nares, but without evidence of pus either in these cells or in the sphenoid which was subsequently drained. I may say that thanks to Doctor White my patient has completely recovered, she is free from pain, her neuritis has entirely subsided without evidence of atrophic change, and her visual acuity is normal.

When the very close relation between the canal of the optic nerve and the sphenoidal sinus and posterior ethmoid cells is considered, the optic nerve disturbances should be easily appreciated. In some cases the process is undoubtedly a toxæmia and the highly organized optic nerve fibers to the fovea are the first to suffer which explains the frequency of central scotoma. Toxic process involving the optic nerve itself may later account for narrowing of the visual field. Could I ask Doctor Luedde how relatively frequently he has been able to establish central scotoma, how frequently he has noted a condition of advanced optic neuritis as in the case which I have been privileged to cite, and how often it has been his experience that ophthalmoscopic findings have been the dominant factors in the recognition of trouble in the sphenoid or in the posterior ethmoid cells.

Considering the question of toxins or of focal infections may I ask how frequently suppuration in the accessory nasal sinuses may be held responsible for uveitis. With the prevalence of ethmoidal disease, is it not strange that we should not more frequently come upon cases of uveitis associated with or responsible for this disorder? Is this disassociation due to the fact, as Posey suggests, that there may be some controlling mechanism which prevents the ocular circulation from participating in the inflammatory conditions, just as there is a control of the intra-ocular circulation which makes it partially independent of the general circulation?

Turning from clinical manifestations to pathological changes arising from disease in the nasopharynx, Doctor Luedde emphasizes the query that I have already made; that with a vascular and lymphatic circulation practically identical, why do not the associated ocular manifestations which he has cited invariably or at least much more frequently become established in the presence of suppuration in the sphenoid or in the posterior ethmoid cells? Is it possibly true that within the orbit and the various branchings of the ophthalmic artery the toxins are combated by an unusually rich blood supply?

With Doctor Luedde I feel satisfied that certain pathological manifestations can no more be determined as of nasopharyngeal origin than any low grade infection, chronic inflammation, or possibly even more acute types can be determined histologically. A microscopical study of the tissue is frequently equally baffling if very exacting demands are made upon our interpretation of tissue change or cell alteration. It is true that tuberculosis may demonstrate endothelioid cells, giant cells, and caseation, with possibly tubercle bacilli in the tissues; that lues may manifest cells of the Langhans type, perivasculitis, and changes in or about the vessel walls. But quite frequently any low-grade form of inflammation such as that of the teeth, appendix, prostate, gall bladder, lower bowel will manifest histological changes which will baffle histological interpretation.

Regarding the effective treatment of orbital infections and the arresting of serious trouble within the eye, let us consider the case of the suppurating tear sac. At least 30 per cent of all ulcers of the cornea are associated with and consequently responsible for chronic suppurative disease in the lacrymal sac. An originally more or less benign infection may assume within the sac a virulence of intensity which the micro-organism formerly did not possess and has now acquired through a suitable habitat, blood heat, frequent transfer, association with micro-organisms of another class. This fact was pointed out years ago by Plaut and von Zelewski. What takes place in front of the

eye may equally well occur behind it. With the removal of a tear sac, an ethmoid and the drainage of a sphenoid, or more remotely still, the enucleation of a tonsil, each possibly harboring let us say a pneumococcus infection, one is at least smothering the fire before the rest of the structure or the adjoining buildings have burst into flames.

Doctor Luedde has sounded a note of warning toward the close of his paper not only regarding the importance of the early establishment of an associated diagnosis but also regarding the importance of early surgical interference. For we must surely appreciate that from the nasopharynx, as from many other foci, septic processes may originate a generalized arthritis, of common character as of common origin to the eye condition, and which may, long after the originally septic focus has been detected and eradicated, continue to maintain a chronic form of virulence through the blood stream.

I am sure that Doctor Luedde agrees that with the better understanding of the relationship between ocular and nasal disorders there has developed a need for a broader knowledge of nasal surgery and of the necessity of surgical interference on the part of the ophthalmologist. The ophthalmologist may not feel competent to undertake these surgical measures, granted that he has particular facilities for clinical interpretation not in the possession of the rhinologist. Though unable to undertake these surgical measures, he should at least be thoroughly familiar with the surgical anatomy of the nose and of the accessory nasal sinuses. He should be called upon with increasing frequency as a consultant in operations to be undertaken in this region and should take part in the operations upon his own cases which his increasing knowledge of the subject will lead him to refer to the nasal surgeon for operation.

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UNILATERAL ATROPHIC OPTIC NEURITIS[1]

By WILLIAM THORNWALL DAVIS, M.D., Washington

THE majority of cases of unilateral atrophic optic neuritis result from skull injury, direct injury of the nerve itself, local inflammation of the orbit, brain tumor, and hæmorrhage into the nerve sheath. The etiology of 60 per cent of the cases remains unsolved.

Gunn observes that from the embryological development and structure the optic nerve is to be considered as part of the central nervous system.

The sheaths of the optic nerve and the spaces between them are continuous with those of the brain. This continuity is of pathological importance. The situation of the optic nerves and commissure at the base of the brain renders them liable to involvement in basal meningitis, pressure from new growths, aneurism, or a distended third ventricle. After its entrance into the optic canal the optic nerve has all the exposures of a peripheral nerve. In the canal it may be pressed upon by a diseased ophthalmic artery; it may be involved by a syphilitic affection of the bone and from sinus disease, particularly sphenoid or ethmoid. It may be injured in fractures of the base of the skull, of the orbit, or of the foramen; or by the plastic exudate caused by such fracture. There is a strong analogy between inflammations of the optic nerve and the facial nerve in the passage of the latter through the wall of the skull.

The dural sheath within the canal is intimately applied to the pial sheath though not so closely but that fluid may pass. When a meningitis occurs these spaces may be closed in only one of the nerves and this would have an important bearing on the possibility of unilateral papillœdema developing as a result of increased intracranial pressure.

In the orbit the nerve may be inflamed along with the other tissues as a result of orbital cellulitis or facial erysipelas. It may be injured in orbital wounds or pressed upon by tumors or hæmorrhage into the sheath.

At its termination, the papilla, the nerve may suffer from a secondary atrophy due to a peripapillitic degeneration or a cutting off of the blood supply. Continuously increased intra-ocular tension may affect it.

At its passage through the lamina cribrosa the fibers may be strangulated by pressure due to swelling of the fibers, either of the nerve bundles or of the fibers of the lamina.

There may be inflammation and degeneration of the nerve fibers secondary to destruction of the ganglion cells in the retina from reduced blood supply, as in obstruction of the central vessels or retinal detachment; from toxic materials such as alcohol, tobacco, carbon bisulphide, etc., acting directly upon these cells; or from heredity influences such as amaurotic family idiocy.

What Jackson says of the classification of atrophy may well be applied to neuritis. That we have at present no satisfactory system of classification is obvious. No pathological classification is possible owing to our lack of knowledge of the earliest stage of this process.

Neuritis and atrophy are always a result of antecedent morbid processes. Atrophy is an organic degenerative change marked by shrinking with loss of characteristic structure and function. It is the end-result of many morbid processes. In the optic nerve we have within the neural sheath the fibers, axis cylinders, and medullary sheaths, the glial supporting tissue and the connective tissue septa dividing the nerve into its chief bundles carrying the blood vessels with their various coats and contents. It is conceivable that any one of these histological constituents might be the starting point of the change in optic neuritis and atrophy. The anatomical and physiological unit of the nervous system is considered to be the axone and hence the pathological change of neuritic atrophy may be outside the nerve stem. Hence our present classification rests mostly on etiology.

Of intracranial tumors, those of the middle fossa of the skull are more apt to cause a unilateral papillitis.

Optic neuritis is present in 100 per cent of tumors in the corpora quadrigemina and 89 per cent of cerebellar tumors. In the majority of such cases it is unilateral. Horsley holds that the neuritis when bilateral is more pronounced on the side of the lesion.

Subtentorial abscesses are more frequently accompanied by neuritis than abscesses in the cerebrum. Growths or abscesses in the cerebellum or corpora quadrigemina, or intraventricular tumors bring about closure of the iter, thus producing an internal hydrocephalus. The foramina of Magendie and Luschka may become occluded by lymph or be closed by scar stenosis resulting from meningitis. The production of

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October, 1926.

internal hydrocephalus produces increased intracranial pressure which causes collapse of the delicate cerebral veins and consequently a decrease in the cerebrospinal fluid absorption. Likewise this increased pressure tends to drive the cerebrospinal fluid into the sheath of the optic nerve. When there are adhesions of the sheath due to previous meningitis there will be unilateral papillœdema.

Among the affections of the brain, other than tumor, that may cause optic neuritis are foci of softening, sinus thrombosis, aneurism, cerebral hæmorrhage and cysts.

In children the most frequent causes of optic neuritis are chronic meningitis, hydrocephalus, and tubercles.

A malformed skull, as tower skull, is a frequent cause of optic neuritis. It is a rare complication in certain spinal diseases, such as acute myelitis, tetany, and multiple neuritis.

According to Fuchs the only cases of optic neuritis that may be designated as purely local are those due to orbital affections such as inflammation, new growths, or tumors on the optic nerve itself. There may be a slight papillitis associated with retinitis stellata. The latter may be unilateral and is most frequently seen in youth.

In thrombosis of the superior longitudinal sinus, which may occur in chlorosis, typhoid, or marasmus, the papillœdema which may be unilateral is thought to be due to occlusion of the main channel for the discharge of the surplus cerebrospinal fluid.

Skull fractures cause a large percentage of unilateral optic neuritis cases, particularly fractures involving the base of the skull or the bones of the orbit. Blows on the head in the neighborhood of the supra-orbital foramen are apt to cause fracture of the supra-orbital plate or a periostitis in the neighborhood of the optic foramen.

Often in head injuries, particularly in this neighborhood, there will be a neuritic atrophy without demonstrable fracture; there is probably a line fracture in the neighborhood of the optic foramen.

Indirect injury to the nerve itself may be caused by a blow on the external angular process without other demonstrable lesion. The primary impairment of vision and loss of the temporal field may be followed by atrophy.

In these cases of indirect injury we are dealing with indirect fractures of the walls and particularly the upper wall of the orbit, the fractures being continued into the optic canal so that the nerve is crushed or lacerated. Such injuries may cause subdural hæmorrhage compressing the nerve.

Pringle thinks that monocular blindness from diffuse violence to the skull is in the majority of cases due to hæmorrhage into the nerve sheath. He quotes a series of 395 skull fractures treated at the royal infirmary; 186 patients recovered; 1 patient suffering loss of vision in 1 eye. Of the 209 that died, necropsy was done on 174; of these, 13 showed fracture involving the optic foramen; 16 showed hæmorrhage into the sheath of the optic nerve.

The hæmorrhage may be from one of three sources: (1) the subdural space, (2) rupture of the vessels passing between the nerve and its coverings, or (3) the central vessels of the retina which run a short distance inside the dural sheath before they enter the substance of the nerve. The hæmorrhage begins at the distal extremity of the nerve close to its entrance into the eye.

There is no reason to doubt that an intravaginal hæmorrhage of the optic nerve may result from violence to the skull without a fracture as a result of the varying tensions produced in the tissues of the orbit and cranium by the violence. The loss of vision in this type of case is due to (1) effusion of blood, (2) depressed bone compressing the nerve, or (3) direct injury to the nerve itself.

Pringle operated in 3 typical cases of this kind when there was no demonstrable fracture, in the hope of saving vision. Blood under tension was found in the optic nerve sheath. These patients came to operation 2 to 4 weeks after the injury. There was no restoration of vision but this may have been due to the lateness of the operation.

Brav reports a case of unilateral atrophy in a child of 4 years following fracture of the base of the frontal bone. In adults such atrophy is not uncommon but it is rare in children.

Instrumental delivery is undoubtedly one of the frequent causes of neuritic atrophy in children. Frequently it is not discovered until an amblyopia is noted in an examination later in life. It may be discovered accidentally.

Wildy reports a case of atrophy following a right supra-orbital injury producing a short period of unconsciousness. On regaining consciousness the patient found he was blind in the right eye. Such cases were formerly referred to as supra-orbital amaurosis.

Thoral collected 268 cases of lesions of the visual apparatus following skull fractures, of which 225 affected the optic nerve. He notes that a blow upon the frontal eminence or the external orbital process can produce a fissure of the vault of the orbit which will radiate into the optic canal.

These fractures are not often accompanied by the classic symptoms of basal skull fractures.

In some cases of injury to the spinal cord there may be a low grade optic neuritis but only if the cervical cord is involved. No ocular disturbance is below the second dorsal segment.

In multiple sclerosis retrobulbar neuritis is a not uncommon complication. It is *not* rapid in its development and the central defect is limited in extent; it is frequently unilateral and pursues an irregular course. It rarely causes complete blindness. The sclerotic deposits are found particularly in the region of the central retinal vessels within the intracranial segment of the nerve and in the chiasm. The most important histological changes are in the nerve fibers, neuroglia, and blood vessels.

Amenorrhœa and a papillitis may run a parallel course, both being due to brain disease.

Branner reports a case of unilateral atrophy following exposure to an arc light, while Fisher mentions a unilateral case resulting from an injection of lanolin and olive oil for wrinkles. Neuritic atrophy may complicate polyneuritis.

The neuritis seen in lethargic encephalitis is due in the majority of cases to the internal hydrocephalus and consequent increased intracranial pressure.

Albrecht maintains that choked disc may appear in tetany due to decrease in the calcium salts in the blood and brain with resulting cerebral œdema.

A choked disc following otitic disease indicates intracranial complications, as brain abscess or sinus phlebitis.

In alcoholic polyneuritis, optic neuritis is exceedingly rare; it may be unilateral, mild, or severe and the third, sixth, and seventh nerves are often involved. Rarely Argyll-Robertson pupils may be present.

Mercury, lead, and other heavy metals may produce a polyneuritis with optic neuritis as also may the acute infectious diseases, influenza particularly. Beriberi, leprosy, tuberculosis, carcinoma, and gonorrhœa may be so complicated.

Tedeschi reports one case complicating infantile paralysis. In pseudo bulbar paralysis, eye symptoms are rare but when present consist of optic neuritis and atrophy.

Templeton suggests that optic neuritis occurring early in acquired syphilis should be regarded as an evidence of widespread involvement of the central nervous system in the form of a syphilitic meningitis.

Perineuritis is an inflammation of the sheath of the optic nerve with exudation into the subvaginal space. Among the causes may be particularly mentioned meningitis, gonorrhœa, orbital abscess, orbital traumatism, and parotitis.

In direct injury to the optic nerve there is immediate blindness followed by descending atrophy; a traumatism of less degree results in neuritis or choked disc followed by atrophy.

Camerer and McClintock report two such cases of direct injury, one due to penetration of the orbit with a fencing foil followed by immediate blindness, the other due to a thrown table fork penetrating the orbit followed by blurring and whitening of the disc. Such injuries are apt to be committed by agents like the ferrule of an umbrella, flying pieces of steel, glass or small caliber bullet. These may injure the nerve or its sheath or there may be pressure from a clot in the orbit, within the sheath or in the optic foramen, or injury to the nerve from the results of a fracture.

Primary tumors of the nerve are rare; some have the structure of endotheliomata, and spring from the dural sheath.

Fibromata, sarcomata, and myxomata which spring from the subarachnoid trabeculæ, pial sheath or septa thereof, or the glial tissue of the nerve have a common character, being a manifestation of neurofibromatosis. Early blindness is a common characteristic with first a neuritis followed by atrophy; later there is exophthalmos and interference in mobility, etc. One case was reported by Ellett in which the fundus appeared normal.

Unilateral optic neuritis atrophy with hemiplegia on the opposite side of the body is probably due to thrombosis of the cavernous portion of the internal carotid artery. If there is an extension of the thrombosis or formation of an embolus the ophthalmic artery will become occluded.

McCallum, director of Egyptian Hospitals, made the following classification of optic atrophy:

1. Primary as in spinal or vascular disease.
2. The result of retrobulbar neuritis.
3. Postneuritis atrophy.
4. The result of disease of the retina and choroid.
5. After compression or injury of the nerve.
6. Unknown causes.

Of this classification those conditions included under (1) vascular disease, (4) unilateral, retinal, or choroidal disease, (5) after compression and injury of the nerve, are apt to cause unilateral neuritis with atrophy.

Axenfeld, discussing cerebrospinal meningitis, remarks that pressure of the exudate upon the base of the brain, particularly in the neighborhood of the optic foramen, causes at times optic

neuritis and atrophy. Such pressure blindness may disappear after several months. Aside from compression, the inflammation may extend along the sheath to the papilla as perineuritis descendens.

Neuritis is less frequent in the suppurative primary epidemic meningitis than in the tuberculous form. It is frequent in the otitic and other transmitted forms of meningitis.

Papillitis and atrophy may complicate acute superior hæmorrhagic poliencephalitis.

In the epidemic form of meningitis, neuritis with atrophy takes first place among ocular symptoms. This is also true of tuberculous meningitis in which optic neuritis is the most common symptom.

In pachymeningitis interna hæmorrhagica, a choked disc or a papillitis is frequently due to hæmatoma of the sheath of the optic nerve. Unilateral choked disc in this condition is a particularly valuable aid in diagnosis.

There is a rare form of chronic retrobulbar neuritis with mild papillitis due to atheroma or sclerotic changes in the central retinal artery. The interference with nutrition and pressure due to increase in the size of the vessel causes death of some of the fibers of the papillomacular bundle. An absolute scotoma results which is not strictly central.

Genet reports a case of optic neuritis which was the first intra-ocular lesion in a patient with Bright's disease; the nerve disorder ran a typical course without retinal hæmorrhages or exudates. Certain patients with severe neuroretinitis show little or no evidence of renal insufficiency though they may have marked vascular hypertension, moderate peripheral arteriosclerosis, and cardiac hypertrophy. The marked contraction of the smaller retinal vessels seems to be the determining local factor in the production of retinitis.

The advent of the neuroretinitis in these cases is usually of serious prognostic significance, though not always. In certain cases the retinitis is the symptom which directs the attention of the patient to himself. The apparent good health may in exceptional cases last for a long time.

White, from a study of the relationship between the optic nerve disturbances and the size, shape, and pneumatization of the optic nerve canals as determined in a series of 25 cases, draws the following conclusions:

1. The optic canal is normally circular and approximately 5.5 millimeters though it may be from 3.5 to 6.5 millimeters.
2. The smaller the canal the greater the pneumatization, narrowing, and distortion.
3. The size and shape of the canal can be determined by careful radiography.
4. There is greater danger of permanent impairment of vision in a canal abnormally small when a neuritis occurs than there is under the same circumstances when the canal is normal in size; here spontaneous recovery may be expected.
5. Neuritis in normal or large canals seems usually to be of extranasal origin.

Cases are reported of retrobulbar neuritis with consequent papillitis from ascaris lumbricoides, exposure to cold, emphysema of the lungs, uterine disease, leucocythæmia, and lavage of the stomach. The papillitis due to influenza is of the acute retrobulbar variety, coming on 8 to 12 days after the onset of the influenza and preceded by pain.

Exposure neuritis usually is unilateral and is preceded by severe temporal and frontal pain. The character of the process is like that developed in influenza but the scotoma is seldom absolute.

There were 35 cases of unilateral neuritic atrophy seen in private practice. These cases were exhaustively studied with the following conclusions as to etiology. Syphilis, 3; dental infection, 1; tonsillar infection, 2; brain tumor, 2; encephalitis lethargica, 1; nasal accessory sinus disease, 2; mumps, 1; chronic arsenical poisoning, 1; cardiovascular disease, 3; exposure to cold, 1; secondary to disseminated choroiditis, 1; multiple sclerosis, 1; facial erysipelas, 1; skull injury, 1; senility, 1; birth injury, 1; contusion of the globe, 1; toxæmia of pregnancy, 1; undetermined, 9.

CÆSAREAN SECTION FOLLOWED BY TEMPORARY EXTERIORIZATION OF THE UTERUS

THE PORTES OPERATION[1]

By LOUIS E. PHANEUF, M.D., F.A.C.S., BOSTON

CÆSAREAN section followed by temporary exteriorization of the uterus was first done by Dr. Louis Portes at the Maternité de Port Royal de Paris, on the service of Dr. Demelin, December 14, 1923. The first case was reported to the *Société d'Obstétrique et de Gynécologie de Paris*, at its meeting of March 10, 1924. Since the first case was reported a number of these operations have been done in France.

The method does not enter into competition with the conservative cæsarean section, be it classical or low cervical, but it is of value in neglected cases in which it would be hazardous to undertake the latter methods. It, therefore, is never considered in clean or relatively clean cases. The low or cervical cæsarean section has its greatest advantages in the clean or the presumably infected case, but does not offer the same degree of safety that does the Portes operation in the frankly infected or hopelessly neglected case in which an indication for abdominal delivery arises. It is therefore never an operation of choice but one of necessity.

Its largest field of usefulness is represented under four conditions:

1. When frank infection is present, the child is living, and the condition of the pelvis is such that abdominal delivery is indicated.

2. In the presence of infection and of a dead child when delivery by the natural passage, if not impossible, is at least fraught with danger.

3. When any maneuver through the birth canal might result in the rupture of the uterus. The operation is indicated in such a case even though the child is dead. This applies especially in the neglected labor case with marked uterine retraction. In this type of case it is safer than craniotomy on a dead child, or even embryotomy, as either of these procedures performed within a retracted uterus may well lead to rupture.

4. In the presence of a pelvic indication for abdominal delivery with fetal putrefaction and grave maternal infection.

It is a known fact that a woman subjected to long labor and repeated attempts at delivery is a poor risk for an extensive abdominal operation; and yet most authors agree that in that type of case the cæsarean section should be followed by hysterectomy because of the greater safety afforded by this procedure. The hysterectomy is often done at the worst possible time, the patient being in a state of shock. In surgery the poor risk is more and more frequently being operated on in two stages, and there is no reason why the obstetrical patient should not receive the benefit of this advance in surgery.

The Portes operation, the technique of which follows, is done in two stages. The first stage consists in making a long abdominal incision, delivering the pregnant uterus, closing the abdominal wall behind it to the cervix, making a high uterine incision, extracting the child, placenta, and membranes, closing the uterine incision and allowing the uterus to remain on the abdomen. This part of the operation is rapid and results in but little shock.

As far as the second stage is concerned, two methods may be used: First, if the patient does well, involution of the uterus is allowed to take place, and when the uterus is clean and the uterine incision well healed, the abdominal incision is re-opened and the uterus and adnexa are replaced in the pelvic cavity. Drainage is placed behind the uterus, and the abdominal wall is closed. If, on the other hand, the sepsis seems uncontrollable, a hysterectomy may be performed, extra-abdominally, following the Porro technique, after the state of shock has passed. This was done successfully in one case with the patient in bed, without anæsthesia. At the February 9, 1925, meeting of the *Société d'Obstétrique et*

[1] Presented at the October 19, 1926, Meeting of the Obstetrical Society of Boston.

No.	Reported by	Reference	Condition of Uterine Scar	Time Between the Two Operations	Result	
					Mother	Baby
1	L. Portes (Paris)	Operation Dec. 14, 1923. Gynéc. et obst., Par., 1924, x, 241	Superficial sepsis	20 days	Well	Well
2	L. Portes (Paris)	Idem, p. 244	Separation of seroserous suture on eighth day, otherwise clean	33 days	Well	Well
3	L. Portes (Paris)	Idem, p. 246	Slough and complete separation of uterine incision	57 days	Well	Well
4	L. Portes (Paris)	Idem, p. 249	Healed by first intention	25 days	Well	Well
5	P. Berson (Paris)	Bull. Soc. d'obst. et de gynéc. de Par., 1924, xiii, 586	Healed by first intention	17 days	Well	Well
6	P. Berson (Paris)	Idem	Healed by first intention	15 days	Well	Well
7	R. Vaudescal (Paris)	Idem, p. 787	Almost complete separation of uterine incision. Closed spontaneously	39 days	Well	Well
8	Maurice Rivière and Marc Rivière (Bordeaux)	Idem, 1925, xiv, 363	Separation of incision	54 days	Well	Well
9	Maurice Rivière and Marc Rivière (Bordeaux)	Idem, p. 364	Slight separation of seroserous suture at upper angle	41 days	Well	Well
10	M. Audebert (Toulouse)	Idem, p. 485	Slough and complete separation. Secondary suture	Not stated	Well	Well
11	Palacios-Costa (Buenos-Ayres)	Idem, p. 511	Complete separation of incision	45 days	Well	Well
12	Risacher and Lafitte (Paris)	Idem, p. 644	Sepsis increasing in severity	Hysterectomy on second day without anæsthesia in patient's bed	Well	Still-born
13	Paul Guéniot (Paris)	Idem, 1926, xv, 40	Small superficial slough and suppuration	39 days	Well	Well
14	Laffont Houël Duboucher Jahier (Alger)	Idem, p. 473	Slough and separation of incision	57 days	Well	Well
15	Laffont Houël Duboucher Jahier (Alger)	Idem, p. 474	Uterus seemed to slough in its totality on the eighth day	Hysterectomy on eighth day	Died on ninth day	Still-born
16	Picard, P. (Douai)	Idem, p. 583	Slough and separation. Secondary suture. Again separation of lower end of uterine incision	Hysterectomy on about the eighty-sixth day	Well	Well

de Gynécologie de Paris, Professor A. Couvelaire stated that he knew of 32 cases in which the Portes operation had been performed and the uterus returned to the pelvic cavity, with 2 deaths or a mortality of 6.2 per cent[1]. This mortality is extremely low if one considers the fact that these were cases of frank infection.

All these women who recovered saw the return of their menstrual function and resumed their duties with comfort. At first the obstetrical future of these patients was naturally

[1] Bull. Soc. d'obst. et de gynéc. de Par., 1925, xiv, 148-149.

questioned, but it has been proved that a woman with a uterus which has been exteriorized and returned to the pelvic cavity may conceive and carry a pregnancy to term, as shown by the following observation.

At the July 5, 1926, meeting of the *Société d'Obstétrique et de Gynécologie de Paris*, Professor A. Couvelaire reported the case of a woman having previously been delivered by the Portes operation, who successfully carried a pregnancy to term. The Portes operation was performed on July 18, 1924, and the parturient was delivered of a male child weighing 7.4 pounds (3,430 grams). The uterus was returned to the abdominal cavity on August 2, 1924, it having been extruded for 15 days. She left the maternity hospital on August 16, 1924, with her child, and resumed her occupation of housewife. The second pregnancy evolved normally. She started in labor late on July 4, 1926, and early on July 5, 1926, she was delivered at the Baudelocque Clinic, by Dr. Portes, by a classical cæsarean section. The child was alive and weighed 7.1 pounds (3,250 grams). There were only a few omental adhesions to the abdominal wall, the uterus was free and without adhesions, and the uterine scar was good.[1]

I am indebted to Professor Couvelaire and to Dr. Portes for the privilege of seeing this woman and her child at the Baudelocque Clinic, on the day of her delivery, July 5, 1926.

Since the publication of the original operation of Dr. Portes, I have been able to collect the details of 16 cases from the French literature. They are grouped in tabular form for the sake of convenience.

TECHNIQUE OF OPERATION

General anæsthesia is used and the operation performed in two stages.

First stage. The patient is given a general anæsthetic and the abdomen opened by an incision extending from slightly above the symphysis pubis to the xiphoid cartilage. The pregnant uterus is delivered, covered with sterile moist towels and turned toward the symphysis pubis. The traction on the uterus should not be too great. The abdominal wall is closed in one layer behind the uterus down to the cervix with double silkworm gut stay sutures booted with small rubber tubing. (In France they use silver or bronze wire.) The closed abdominal wall is then covered with a sterile towel; the uterus is dropped on it and wicks are carefully placed around the cervix to prevent leakage in the abdominal cavity. A high midline incision encroaching upon the fundus of the uterus is made. The low angle of the incision should not be too low so that it will not pull down in the abdominal cavity when involution of the uterus has taken place. The child, placenta, and membranes are extracted and the uterus is sutured in two layers with No. 2 chromic catgut, the first interrupted and the second continuous. (In France they use silk sutures for the deep layer.) The uterus is now covered with dressings and left on the abdomen. A tight abdominal bandage is applied to keep the uterus flat on the abdomen as its anteflexion causes pain.

Second stage. When the uterus is clean and the uterine scar is firm, the abdominal incision is re-opened up to about the umbilicus. The adhesions are freed from behind the cervix, from the uterovaginal pedicles laterally and from the abdominal wall anteriorly. The uterus is dropped back in the abdominal cavity, and a large cigarette drain is introduced into the cul-de-sac of Douglas and allowed to come out of the abdominal wall behind the uterus. The abdominal wall is again closed in one layer with double silkworm gut stay sutures.

REPORT OF CASE

Mrs. B. F., aged 38, a housewife, born in Ireland, was admitted to the Carney Hospital on October 17, 1926. Her father, mother, 2 brothers, and 4 sisters were living and well, the only death in the family being that of a sister who died during infancy, the cause being unknown. The patient had been breast fed; she does not remember at what age she walked; she had measles and pertussis. A few years ago she was severely burned about the face, neck, and forearms. She was treated at the Carney Hospital, where she remained for 4 weeks. Her occupation before marriage had been that of chamber maid. Her menstruation was established when she was 14 years of age; her periods were regular, of the 28-day type and lasted 2 to 3 days; the flow was scant, there was no pain and no clots were observed. The last period had occurred on January 10, 1926. Her confinement was expected for October 17, 1926. She was married when she was 22 years of age and had had 3 previous

[1] Bull. Soc. d'obst. et de gynéc. de Par., 1926, 423-424.

pregnancies, the first terminating in her home as an instrumental delivery of a full term male child. The second pregnancy also reached full term and a second instrumental delivery of a male child was accomplished in her home. Both of these children are well today. The third pregnancy ended in a miscarriage at 3½ months. She was cared for in her home and curetting was not done. The puerperia were normal.

She started in labor in the early morning of October 17, 1926, in her home. At 9:30 a.m. ether was administered and an instrumental delivery attempted. There were six attempts at high forceps delivery which were unsuccessful. The patient was then sent to the Gynecological and Obstetrical Service of the Carney Hospital, where she was admitted after 13 hours of labor.

She weighed 210 pounds; her appetite had always been good and her bowels regular; there were no urinary symptoms; there was no leucorrhœa, and the patient was not subject to headaches.

Examination. The examination was essentially negative except for the obstetrical findings. A large fetus was presenting by the vertex in right occipito posterior position; the fundus of the uterus was near the xiphoid cartilage. The uterus was firmly retracted on the fetus. The fetal heart tones could not be heard on auscultation. The vulva was markedly œdematous and showed a number of ecchymotic areas. On rectal examination it was found impossible to reach the presenting part. We were practically certain that we were dealing with a dead baby. Despite this fact, the uterus was so firmly retracted that it was thought that an attempt at craniotomy or embryotomy would result in a ruptured uterus. The patient was in a marked state of shock, was coming out of ether, and was having very frequent and strong contractions. Her temperature was 99.4 degrees F. (37.3 degrees C); pulse 128; respirations 32, and the white blood count 26,200. On admission the parturient was given 1,000 cubic centimeters of salt solution under the breasts and ¼ grain (.015 gram) of morphine sulphate hypodermically. It was thought that she was in too much shock to stand a cæsarean section followed by a hysterectomy, and since labor pains were strong and frequent, it was evident that she should be delivered at once. It was therefore decided that the method which offered her the greatest safety was a cæsarean section followed by temporary exteriorization of the uterus (the Portes operation).

Operation—cæsarean section with temporary exteriorization of the uterus. The patient was catheterized, taken to the operating room and given ether. The abdomen was opened by a long incision starting near the symphysis and ending near the xiphoid, the incision being carried upward to the left of the umbilicus. The pregnant uterus was delivered; the abdominal wall was sutured in one layer with double stay sutures of silkworm gut up to the posterior wall of the cervix. The abdominal wall was then covered with a towel and the pregnant uterus was dropped on it. A high incision was made in the anterior surface of the uterus, extending over the fundus. A stillborn male child, weighing 10 pounds 2 ounces (4,636 grams), was extracted by the breech with great difficulty, as the uterus was firmly contracted on it. The placenta and membranes were removed through the incision. The contents of the uterine cavity had a foul odor. The uterine incision was closed in two layers with No. 2 chromic catgut, the first layer interrupted and the second continuous. Intermediate sutures of silkworm gut were then placed between the stay sutures to the abdominal wall; one stay suture of silkworm gut was placed anteriorly at the lower edge of the incision. The uterus and the adnexa were allowed to stay on the abdominal wall; they were covered with a moist dressing and a sterile towel, and an abdominal binder was applied. The patient was returned to her bed with a pulse of 136. The baby's head and face were considerably bruised by the previous application of forceps. On the right the skin had peeled over the neck, apparently where the tip of the forceps blade had reached. The head was unmoulded. The time of the operation was 30 minutes.

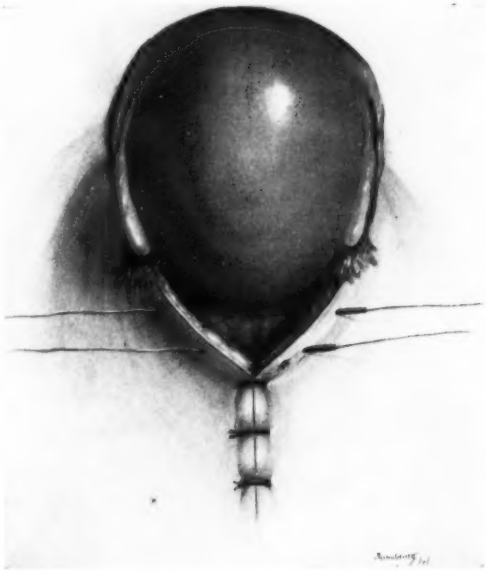


Fig. 1. Portes operation. Median abdominal incision from symphysis to near xiphoid cartilage. The pregnant uterus is placed in marked anteversion to permit the rapid suturing of the abdominal wall.

The sutured abdominal wall is covered with sterile towels; the uterus is dropped on it; gauze wicks are placed around the lower segment and an incision is made on the anterior wall, encroaching on the fundus. The fetus, placenta, and membranes are extracted and the uterine incision is closed in two layers with No. 2 chromic catgut.

The uterus is covered with a moist sterile dressing and a tight abdominal binder is applied.

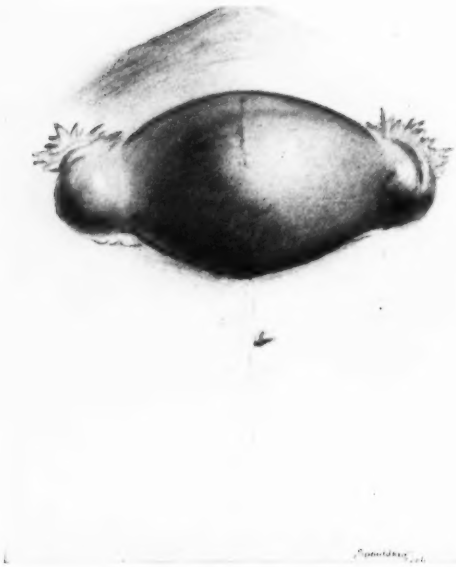


Fig. 2. Portes operation. The uterus after involution has taken place and before it is returned to the pelvic cavity. The uterine scar is hardly visible. The abdominal incision is perfectly healed. The tubes and ovaries are slightly œdematus but the tubes are patent.

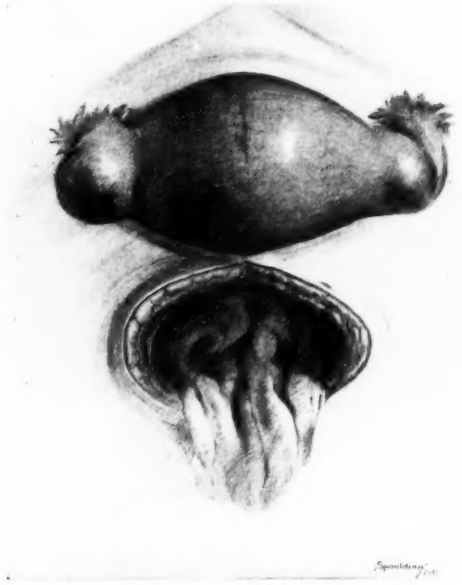


Fig. 3. Portes operation. The abdominal incision is reopened; the intestines are protected with gauze. Intestinal adhesions are exceptional.

Convalescence. October 18. The patient made a good recovery from the ether, with very little vomiting. Twenty-four hours after the operation no symptoms of shock could be noted; the pulse was 100; and no distention was present.

October 19. There was a slight amount of distention, which was relieved by injections of pituitary extract and enemata. The uterus looked clean. The tubes and ovaries were very œdematous. The uterus was dressed with sterile gauze, impregnated with sterile vaseline.

October 20. The patient had a chill. The urine showed marked cystitis. Alkaline treatment was prescribed with bladder irrigations. The suture line of the uterus showed a very slight serous discharge. There was also superficial sepsis of the abdominal sutures at the lower angle of the incision. There was considerable blood stained discharge from the vagina. She looked septic but her condition was not alarming.

October 24. She complained of backache, was not relieved by change in position, and voided in small amounts.

October 25. The backache was apparently due to a distended bladder; 33 ounces of urine were obtained on catheterization and the backache was completely relieved. There was no change in the appearance of the uterus.

October 26. Frank pus appeared through every stitch hole in the uterus. The vaseline dressings were omitted and Dakin's dressings substituted. The uterus was covered with gauze wicks soaked in Dakin's solution.

October 28. The patient was allowed out of bed in a chair as she was stout and there was beginning irritation of her back. Signs of phlebitis in the right leg appeared. The leg was elevated while she was sitting in a chair. The uterus was about one-fourth the original size.

October 30. The abdominal sutures were removed and the incision was well healed. There was a little irritation from the sutures where they had cut in. The uterus looked much better as a result of the Dakin treatment. There was still pus coming from the suture holes and a foul discharge from the vagina.

November 4. The patient was up all day. Her leg had begun to feel better. She was eating well and her bowels were open. The uterus looked clean in every way except for the draining incision which was still discharging pus through the suture holes but the incision itself had healed firmly. The tubes and ovaries were still œdematous but they were apparently not septic. The vaginal discharge had decreased in amount and was less foul. Involution was rapidly taking place.

November 8. The uterine incision had been treated with 2 per cent mercurochrome and the uterus, as

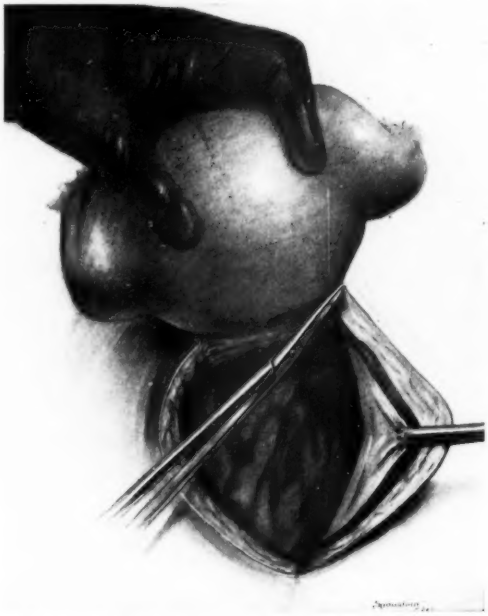


Fig. 4. Portes operation. The adhesions to the utero-vaginal pedicle are, at first, separated with scissors and then with the finger until the pedicle is free from the abdominal wall. The uterus and the adnexa are dropped in the pelvic cavity, where they assume their normal positions.

Fig. 5. Portes operation. Through and through sutures of silkworm gut booted with fine rubber tubing are introduced. A cigarette drain is placed in the cul-de-cac of Douglas and comes out behind the uterus. The gauze is withdrawn, the omentum is brought down, and the sutures are tied.

far as could be determined, was clean. A slight vaginal discharge was present.

November 12. The patient had a rise in temperature with pain in the back. The chest examination was negative.

On November 11, 12, and 13 the uterus was clean and involution was taking place. The patient was complaining of pain in the right lower chest but the sounds were clear.

November 15. The chest signs were typical of pneumonia, there being a patch of consolidation in the right lower lobe.

November 16. The diagnosis of lobar pneumonia of the right lower lobe was verified, and treatment instituted. The phlebitis had cleared up; the uterus was clean and the abdominal incision was also clean. An abscess of the neck to the left of the median line developed in the scar which had resulted from a previous burn. The abscess was opened and drained, considerable pus being obtained. This promptly healed.

November 22. The signs in the chest had disappeared and the patient felt much better. She was eating well and appeared in good health. The uterus was clean; the tubes and ovaries were still œdematous but not septic.

November 26. The uterus was now about the size of an orange. The tubes and ovaries were still slightly œdematous but were clean. The fimbriated extremities were everted, the tubes were patent; the ovaries were slightly larger than normal; the whole uterus, tubes, and ovaries were clean, so far as could be determined. The abdominal wall was clean and the uterine incision had healed firmly, it being rather difficult to find. The patient was prepared for a secondary replacement of the uterus, tubes, and ovaries, the pelvic organs having been extruded for 41 days.

Operation—secondary replacement of uterus, tubes, and ovaries. The abdomen, the uterus, and the adnexa were cleaned with ether, and were then painted with 3½ per cent tincture of iodine, covered with sterile towels and a binder. The patient was given ether and taken to the operating room. Here a coat of 7 per cent tincture of iodine was applied to the abdominal wall, to the uterus, and to the adnexa. The abdominal incision was reopened posterior to the uterus and to a point slightly above the level of the umbilicus. Upon opening the abdominal cavity but one fine omental adhesion to the parietal peritoneum on the right of the incision was found. There were no intestinal adhesions. With scissors and the finger the abdominal wall was freed from the posterior surface of the uterus, from the utero-

Fig. 6. Chart showing temperature, pulse, and respiration.

vaginal pedicles laterally, and from the anterior surface of the uterus. This was accomplished with surprising ease. The uterus and its adnexa were returned to the pelvic cavity. A large cigarette drain was introduced to the cul-de-sac of Douglas and allowed to make its exit behind the uterus and at the lower angle of the incision. The abdominal incision was closed with one layer of through and through double silkworm gut sutures booted with fine rubber tubing. A few intermediate sutures of silkworm gut were placed between the stay sutures. The patient left the table in excellent condition.

Convalescence. November 27. The evening temperature was 102.2 degrees F.; the pulse was 108 and the respirations 24. The temperature at no other time rose above 100. The pelvic drain was removed on the second day; the stitches were out on the ninth day and the incision had healed by first intention. The patient was given a head rest on the tenth day and was allowed out of bed on the twelfth day after operation.

Discharge note. December 10. The incision in the neck was healed, the phlebitis of the right leg had cleared up. The abdominal incision was well healed throughout; there was no induration and no tenderness. The vaginal examination showed an old laceration of the perineum; there was a small cystocele and a small rectocele; the cervix was deeply lacerated, but there was no eversion and no erosion. The cervix was in its normal position at right angles to the vagina. The fundus was slightly enlarged in forward position. The adnexa did not appear to be enlarged or sensitive. There were no masses or areas of tenderness in the pelvis.

December 12. The patient was discharged well, on the fifty-seventh day after admission.

COMMENT

Cæsarean section with temporary exteriorization of the uterus, the Portes operation, is an operation reserved for cases in which infection is severe and abdominal delivery indicated. The indications for this procedure are, therefore, very limited. At first thought it looks like a very radical method, and yet, in the final analysis, it proves to be conservative since it permits preservation of the uterus, tubes, and ovaries. The technique of the operation is very simple and can easily be carried out. In reviewing the reported cases it was found that in every case in which the uterus was replaced, the patient recovered. The uterus was left extruding from 15 to 86 days. It is also possible by this method to remove the uterus extra-abdominally, if sepsis is uncontrollable, at a time when the patient is out of shock. One woman who had the uterus exteriorized, subsequently carried a pregnancy to term and was delivered of a living child by a classical cæsarean section. The function of reproduction may, therefore, be preserved. There is very little peritoneal reaction after the pelvic organs have been returned to the abdominal cavity.

NOTE.—The patient reported for examination on May 6, 1927. She stated that she had menstruated regularly in January, February, March, April, and May. She had abdominal cramps the day preceding her January menstruation but she has had no pain since. Her periods have averaged 3 days. Her general condition is excellent.

The examination revealed a healed abdominal incision. There was a small hernia where the second incision had been drained at its lower angle. The vaginal examination showed old lacerations of the cervix and perineum, the uterus was normal in size, in forward position and movable in all directions, the tubes and ovaries were not enlarged and not tender and there were no masses or areas of tenderness in the pelvis.

She had resumed her duties of housewife and felt well in every way.

CLINICAL SURGERY

FROM THE CHEVALIER JACKSON CLINIC

BRONCHOSCOPY AND ŒSOPHAGOSCOPY

A Brief Consideration of Technique

By CHEVALIER JACKSON, M.D., Sc.D., F.A.C.S., Philadelphia

DANGERS, COMPLICATIONS, AND CONTRA-INDICATIONS

WHEN skillfully introduced there is absolutely no danger whatever from the mere presence of a bronchoscope in the laryngotracheobronchial airway, nor of an œsophagoscope in the œsophagus and stomach. On the other hand, when an otherwise skillful, but endoscopically untaught man starts to introduce either of these instruments into a dyspnœic baby, the chances of the baby's survival are exceedingly remote. It is true that any physician or surgeon can be taught how to introduce these instruments safely; yet it is equally true that he cannot learn how to introduce them by looking on at a clinic. In principle the bronchoscope, the œsophagoscope, and the gastroscope are specula; but their introduction is highly technical as compared to the introduction of a vaginal or rectal speculum. If an œsophagoscope is inserted into the pharynx and simply pushed downward, the one place it will *not* go is into the œsophagus. Only a slight push is necessary to send it through the hypopharyngeal wall where it will meet with less resistance in its progress down between the layers into the mediastinum than it would if it were going down inside the œsophageal lumen.

Dyspnœa. A patient dyspnœic from true asthma is in no particular danger from bronchoscopy; but a patient supposed to have asthma but really dyspnœic from mechanical obstruction of the airway by disease or by foreign body is likely to die on the table unless handled by a team of 3 all trained to act together with promptness and precision. The danger in dyspnœic patients, especially babies, may be as great in œsophageal as in laryngotracheal cases for the reason illustrated in Figure 2.

Trauma. Apart from the trauma of false passage of instruments by the untaught, fatal trauma may be inflicted by improper attempts to deal with a foreign body. A trained man may harmlessly manipulate a safety-pin for a half-hour because he knows that "advancing points perforate, trailing points do not" (3, 8, 10). Furthermore, he not only *knows* this but he is trained until it is impressed upon his subconscious mentality that only an exceedingly slight pull is required to drive a point through the wall of either the œsophagus or bronchus (Fig. 3). The same principle applies to all pointed objects, nails, pins, tacks, hooks, staples, etc.

Contra-indications to bronchoscopy and œsophagoscopy are few and none would contra-indicate endoscopic removal of a foreign body (3). High blood pressure, advanced cardiovascular disease, aneurysm, active syphilis or tuberculosis, and other organic diseases must be weighed against the urgency of the indications for the procedure and call for preparatory treatment of the patient. Pneumonia is no contra-indication and in foreign body cases the supposed pneumonia is usually an error in diagnosis (14). In cases of embolic abscess a moribund condition of the patient may contra-indicate bronchoscopy, not because bronchoscopy would hasten the end but because it would be powerless to prevent it. In babies and in very young children bronchoscopy should not be prolonged beyond 25 minutes, and repetition of the procedure is contra-indicated without an interval of a few days, preferably a week.

Mediastinal emphysema, pneumothorax, and septic mediastinitis are rare complications. They may occur spontaneously before bronchoscopy or œsophagoscopy (3, 10), or may be due to perforation by a safety-pin or other foreign body under manipulation. The gravity of these complications should always be in the mind of the peroral endoscopist to keep his cautiousness up to the utmost.

Mortality. Considered apart from the condition for which it is done, there is no mortality attached

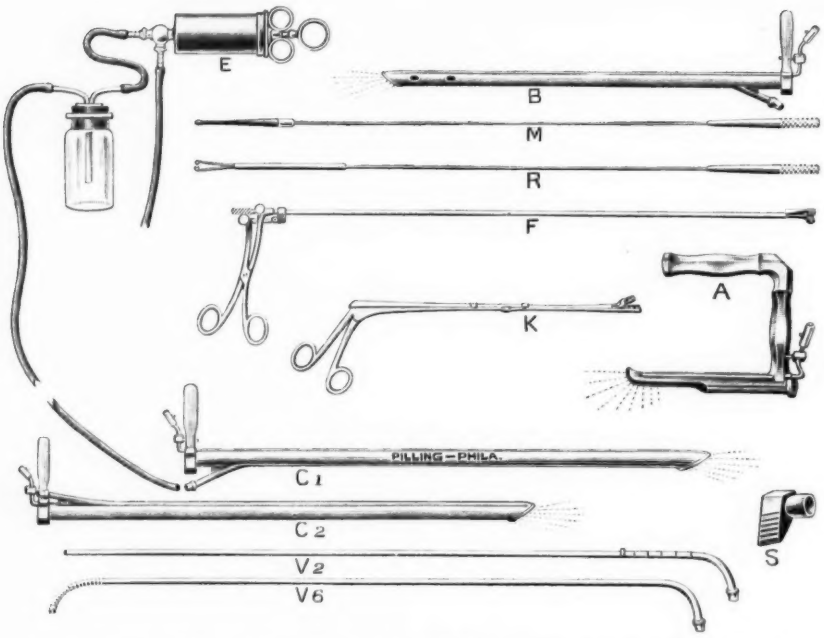


Fig. 1. Peroral endoscopic instruments. *A*, direct laryngoscope; *B*, bronchoscope; *C* and *C2*, œsophagoscopes with aspirating canals; *C1* is preferable for general use; *E*, portable aspirator with positive pressure for clearing canals when necessary; an electric aspirating pump is preferable, especially if it has a positive pressure tubal connection; *M*, œsophagoscopic bougie for safe dilatation under guidance of the eye; *R*, sponge carrier, for gauze sponges; the latter are not shown but are absolutely essential—at least 4 dozen of the proper size for each size of tube to be used should be in readiness on the sterile table. *F*, bronchoscopic and œsophagoscopic forceps; *K*, laryngeal forceps for taking specimens of tissue; a longer form of this forceps is needed for bronchoscopic and œsophagoscopic use; *V2*, aspirating tube; *V6*, spiral tipped aspirating tube (Lynah); *S*, Moore thimble bite block.

to the skillful insertion of a bronchoscope or œsophagoscope. Taking all the cases as they come, those with essentially fatal visceral diseases, such as mediastinal lymphosarcoma, advanced cancer, etc., as well as those presenting difficult mechanical problems of foreign body extraction or foreign body pathology, the mortality, taken over a period of 10 years, is not over 1.7 per cent. In 1926, at the Chevalier Jackson Clinics, there were 4,656 peroral endoscopies done by 8 individual members of the personnel and course graduates. During this period there was but one death shortly after bronchoscopy, and in this case there was no autoptic evidence to indicate that death was directly or indirectly attributable to the endoscopy

PREPARATION OF THE PATIENT

Except in utmost emergency it is essential that every patient be *carefully*, not casually, gone over by an internist or pediatrician (1). High blood-pressure, advanced cardiovascular disease, aneurysm, active syphilis or tuberculosis, and other serious organic diseases, do not necessarily forbid endoscopy, but it is essential that they be taken into consideration in the preparation of the patient. For this reason, careful roentgen-ray examination would be absolutely essential in every case as part of the preparation even if it were not an essential element in the diagnosis. It is essential that the stomach be empty of food notwithstanding the fact that a general anæsthetic is not to be used. The contact of the instruments with the fauces and base of the tongue will cause retching which is of no consequence if there is no food in the stomach. The stomach is never absolutely empty of secretions (3). In cases of œsophageal stenosis the œsophagus should be washed out and well drained.

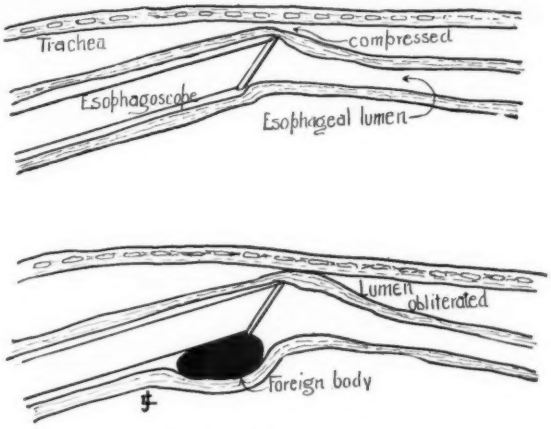


Fig. 2. Serious obstruction of the trachea from crowding of the party wall into the trachea during œsophagoscopy, especially in babies and very young children. Asphyxia will soon result if the condition is not promptly recognized. A proper position of the patient and careful work will serve to avoid all danger of this complication. Even without a foreign body, the bulk of an œsophagoscope may cause dyspnœa in babies, unless a very small tube is used (From advance sheets of *Bronchoscopy and Œsophagoscopy* by Chevalier Jackson, 2d ed. 1927, W. B. Saunders Co.)

Asepsis of the field is impossible; but a clean mouth should be insisted upon in adults and older children. Examination of the mouth for artificial dentures, bridge work, loose crowns, deciduous teeth, etc., is essential to forestall accidents in the use of the bite block and tube. Examination of the nose, the fauces, pharynx, and larynx is always essential. Mirror examination of the larynx for a local lesion or a recurrent paralysis should never be omitted. Rest and relaxation in bed is a desirable preliminary to the first endoscopy, but is dispensed with after the first time in ambulatory patients. A laxative is advisable especially if a sedative is to be used.

TECHNIQUE

Preliminary training. As with all purely manual procedures, education of the eyes and fingers is essential to success; additionally, in peroral endoscopy it is essential to safety of the patient. Anyone who regards it beneath his dignity preliminarily to educate his eyes and fingers in the technique of the cataract operation by practice on sheeps' or pigs' eyes from butchered animals had better not attempt a cataract operation on a living human being. The dead eye affords better preliminary practice anyway because work on it is free from anxiety or stress. And the cataract

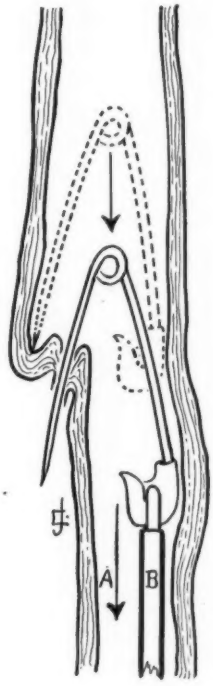


Fig. 3. Schematic drawing of what will happen if the author's dictum, "advancing points perforate, trailing points do not," is ignored. Injudicious traction by the forceps, *B*, in the direction of the dart, *A*, has drawn the pin upward from the position shown dotted and has drawn the advancing point through the œsophageal wall. (From *Bronchoscopy and Œsophagoscopy*, by Chevalier Jackson, 2d ed. 1927, W. B. Saunders Co.)

operation is done under binocular control. Peroral endoscopy is done under monocular control which is not only unusual but involves depth perception with one eye, a thing that is difficult to acquire to a useful degree and impossible to acquire to perfection. Absolutely nothing will take the place of education of the eye *at the tube*. Fortunately, a rubber tube manikin affords an easy, handy, carefree, always ready means of education of the eye and the fingers in all the essentials. The man who will use his spare moments for manipulating various foreign bodies in a rubber tube under guidance of the eye will, with a little training on the cadaver as to the dangers to be avoided and how to avoid them, and on the dog for the problems presented by the movements of the living bronchi, soon make a safe and successful bronchoscopist. Of course, it is essential to have training on the human being

Fig. 4. Position of patient and assistants for introduction of the bronchoscope and œsophagoscope. The middle of the scapulæ rests on the edge of the table; the head and shoulders, free to move, are supported by the assistant, whose right arm passes under the neck; the *right* middle finger inserts the bite block into the *left* side of the patient's mouth. The *left* hand, resting on the *left* knee, maintains the desired degree of elevation, extension, and lateral deflection required by the operator. The left hand is often required to be so high that only the elbow rests on the knee. The patient's vertex should be 10 centimeters higher than the level of the top of the table. It is essential for the assistant to have constantly in mind that the right forearm must not support the neck; all the support must be of the head only and must come from the left hand. This is the Boyce position, which has never been improved upon for bronchoscopy and œsophagoscopy; but for satisfactory results every detail must be precisely adhered to. The assistant holding the head is purposely posed in black clothes to emphasize by contrast the position of the legs. Precisely this position is of utmost importance and drill is necessary before it can be assumed promptly in emergencies and maintained comfortably for a long time when necessary. The foot rest is a box 10 by 12 by 14 inches to give choice of height with stability.

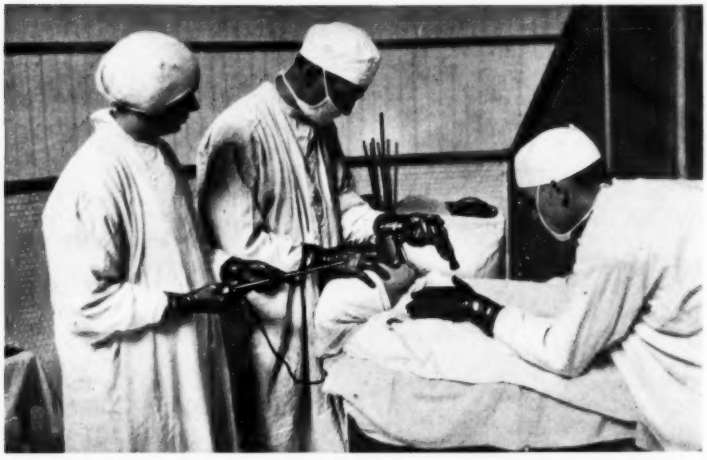


Fig. 5. Exposure of the larynx with the laryngoscope, preliminary to the introduction of the bronchoscope. The bronchoscope is being held by the instrument nurse, point forward, handle to the right. The head of the patient may be lowered later as required to present the orifices and lumina of the bronchi, but at the introductory stage it must be high as shown here, and the operator must be standing. Note that the laryngoscope is in the operator's left hand while his right hand draws the patient's upper lip away from the teeth. It is easier to expose the larynx with the left hand than with the right and it is essential to do it this way. After the glottis is exposed, the operator takes the bronchoscope from the nurse and insinuates it through the larynx under the guidance of the eye at the proximal end of the tube.

also; but we never permit our pupils to attempt to introduce a bronchoscope or œsophagoscope until after they have had at least 2 weeks of intensive instruction and practice on rubber tube, dog, and cadaver. Most of these pupils have been practicing otorhinology for years and hence have had hundreds of hours of practice in depth perception with one eye only. In case of a man who has had training only as a surgeon using both eyes and both hands in open wounds, we would regard a longer preliminary foreign body practice with the rubber tube essential even for endoscopy for disease unconnected with foreign body. The early human endoscopies should be on adults; later on older children; only after prolonged practice and experience is it justifiable to put an endoscopic tube down the tender passages of a baby.

Direct laryngoscopy. Exposure of the larynx to view is the first step in bronchoscopy. The larynx of any human being who can open his mouth can be exposed to direct view, provided the essentials of position and manipulation have been mastered. For children, anæsthesia, general or local, is quite unnecessary, and, in dyspnœic patients, dangerous for this procedure. The entire interior of the larynx of any child, even the newborn infant, can be examined in a few minutes without any anæsthetic, general or local. In adults general anæsthesia is never required; even local anæsthesia may be dispensed with. It is usually advisable, however, to use local anæsthesia in adults, and a sedative may be added if there is no contra-indication. The cocaine solution in about 8 per cent strength is applied with a curved laryngeal applicator to the laryngopharynx and pyriform sinuses in the region of the superior laryngeal nerves. This is usually sufficient, but if the laryngeal reflexes still seem too active a little of the same or a stronger (20 per cent) solution may be applied to the interior of the larynx with a gauze sponge in the straight applicator (R, Fig. 1) after the larynx is exposed to view with the laryngoscope. The patient is then placed in the position shown in Figures 4, 5 and 7. The operator must be *standing* and must remain standing during the examination; crouching on the floor will totally defeat the object obtained by the proper position of the patient. The laryngoscope, held in the left hand in the position shown at *A*, Figure 6, is introduced back along the dorsum of the tongue, and the tip of the epiglottis is exposed to view. The lip of the laryngoscope is inserted beyond the proximal edge of the epiglottis for a distance of more than 1 centimeter in a child, or

2 centimeters in an adult. Then a powerful lifting motion, sufficient to sustain the weight of the patient's head, is imparted to the laryngoscope in the direction of the dart shown at *A*, Figure 6. At this point, particular care to keep the patient's shoulders down on the table is necessary. Prying on the upper teeth as a fulcrum must be avoided. The patient not being anæsthetized, there will be no glottic chink until he takes a deep breath. If the patient is 3 years of age or over he is told to take a deep breath. If he is under that age he will soon do so without being told (9).

It is absolutely essential that the laryngoscope be held in the left hand, and that the use of the instrument never be attempted even once with the right hand; to do so would give the operator a false start that would be a handicap. It is easier to expose the larynx with the left hand than with the right even for right-handed persons. It requires no higher degree of ambidexterity to do bronchoscopy than to use the knife and fork in eating. As in any department of surgery, the bronchoscopist will develop the "lame duck" (left hand) to the greatest possible degree; and no matter how great the degree of ambidexterity developed he will, at times, wish he had a third or even a fourth hand.

Introduction of the bronchoscope. The bronchoscope can be quickly and safely introduced without any difficulty after the larynx is properly exposed with the laryngoscope held in the left hand. General anæsthesia is not necessary and is dangerous in dyspnœic patients. Cocaine is dangerous and quite unnecessary in children; but is generally used in adults. Morphine in full doses may be given to either adults or children (2), and should be administered hypodermically at least an hour and a half beforehand. The patient must be in the position shown in Figures 4 and 5; and the operator should stand up as shown in Figure 5, until the distal end of the bronchoscope is in the trachea (*D*, Fig. 6). Later the operator may sit on a high or low stool as necessary to present a lumen image.

Once the vocal cords are exposed with the direct laryngoscope held in the left hand, as described under the heading, "direct laryngoscopy," the insertion of the bronchoscope is easy. Before the bronchoscope is inserted, a gauze sponge moistened with a 10 per cent solution of cocaine (in adults only) may be passed between the cords and down to the bifurcation and held there for a minute or two. The bronchoscope, illuminated with its own lamp, should be passed to the operator in exactly the proper position for insertion (point forward, "handle" to the right). The operator, after inserting the bronchoscope in the laryngoscope, transfers his eye to the bronchoscope, and, making sure of the presentation of the vocal cords, insinuates the slanted end of the bronchoscope carefully between them with a slightly rotary motion. The exploration of the tracheobronchial tree is a matter of following the lumen, and is greatly facilitated by the position above decribed, which leaves the head of the patient free to be moved about widely in every direction. Though the operator must be standing at the start (Fig. 5), following the lumen, after introduction (*D*, Fig. 6), usually requires the operator to sit. To expose anterior branches, such as the middle lobe bronchus or the anterior branches of the left upper lobe bronchus, requires lowering of the patient's head and a low position for the operator.

BRONCHOSCOPY FOR DISEASE

Diagnosis. The recognition of diseased conditions rests fundamentally on an eye and perceptive faculties trained on the normal; any departure therefrom is quickly recognized. The appearances of many conditions are characteristic. In other cases, removal of specimens of secretions or tissue are essential for diagnosis.

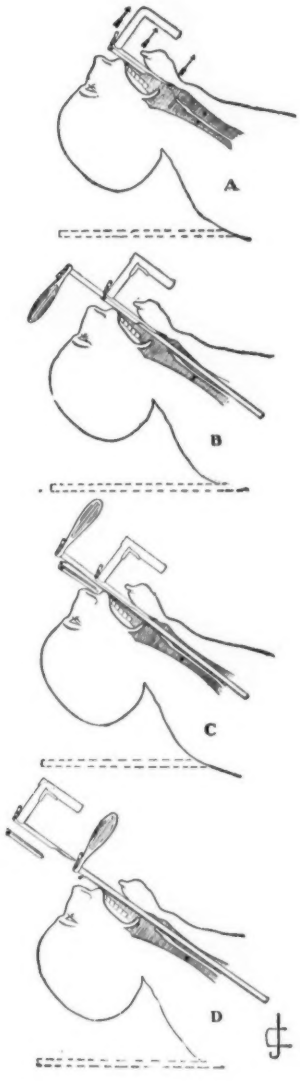
Bronchoscopic Diagnosis of Cancer of the Lung. Here we have a mild, slowly metastasizing relatively benign disease. Only an early diagnosis is required to enable the surgeon to obtain a good percentage of cures. The only way to make the diagnosis early is by bronchoscopy and histological confirmation; this is easily and safely obtained by the endoscopic removal of a specimen with the longer form of the forceps *K*, Figure 1. Metastases cannot travel far in 18 hours, which is all that is required for a histological examination. No complication has followed the taking of a specimen in any case. It is a deplorable fact that cancer of the lung is usually treated for a few years under an erroneous diagnosis.

The technique of bronchoscopic pneumonography was given in a previous issue of this journal (1).

Bronchoscopic treatment of disease. Endobronchial medication is useful in chronic inflammatory conditions, and vaccines prepared from uncontaminated, bronchially removed specimens have been useful adjuncts to medical treatment of suppurative conditions; but the outstanding feature of bronchoscopic treatment is the fact that purulent stagnation can be successfully combated by bronchoscopic aspiration in a certain proportion of cases. In most cases of inspirated foreign body, no treatment other than bronchoscopic removal is indicated.

INTRODUCTION OF THE ŒSOPHAGOSCOPE

The first thing to realize is that if an œsophagoscope is simply put into the pharynx and pushed upon, it will not go into the œsophagus, but into the tissues of the mediastinum. Œsophagoscopy is so totally unlike the introduction of a soft rubber stomach tube that the practitioner uninformed of the difference will almost certainly cause perforation with the œsophagoscope. It is essential that close attention be given to the following details. The introduction of the œsophagoscope calls for the exact position of the patient described (Fig. 4). With the œsophagoscope vertical, the standing operator finds the right pyriform sinus by sight, no mandrin being used (Fig. 7). Passing downward, the operator finds the first obstacle at the bottom of the hypopharynx, in the rigid contraction of the cricopharyngeus muscle. It is necessary to wait for this to relax, but while waiting continuous *gentle* advancing pressure must be maintained and at the same time the œsophagoscope must be pressed anteriorward by the left thumb, to lift it away from the posterior weak point, where it otherwise is almost certain to perforate. This must be done without lowering the head of the patient. The "handle" of the œsophagoscope is not grasped in the hand. It must be *up*, by which we know the lip of the tube-mouth is anterior and away from the danger point. The general direction of the entire œsophagoscope is maintained by aiming for the median line as indicated by the midline of the sternum, notwithstanding the fact that we are starting from one side, in the right pyriform sinus. Care must be taken not to point clear across toward the left side. The opening of the lumen is watched for in the *anterior* part of the field. The relaxation of the cricopharyngeal pinchcock is usually accompanied by a regurgitation of saliva, and the slanted end of the tube-mouth glides over anterior to the relaxing cricopharyngeus muscle. The rush of saliva is quickly and automatically removed by the aspirating canal if the handle of the œsophagoscope is up as it should be. Exploration of the thoracic œsophagus is simply a matter of following the lumen as it opens up ahead, a procedure easy of accomplishment when the head is held in the air, free to be moved in every direction, as indicated above. The operator follows the lumen, the assistant follows the operator with the patient's head. At the hiatus œsophageus, the œsophagus goes through the diaphragmatic pinchcock. Just as the rubber tube of a burette is pinched tightly shut by the spring clip known as a pinchcock, just so



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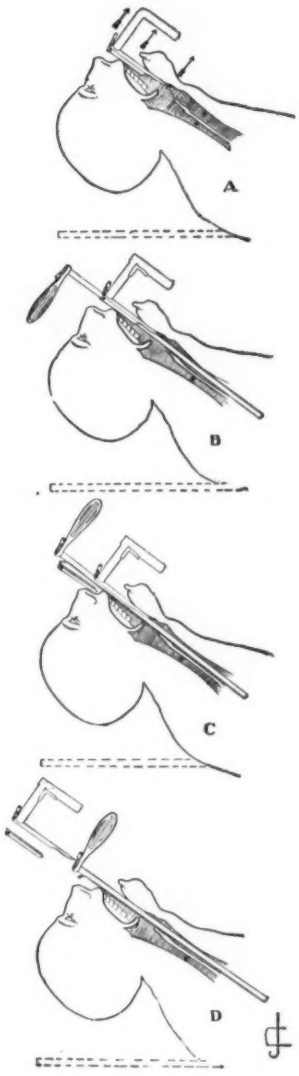

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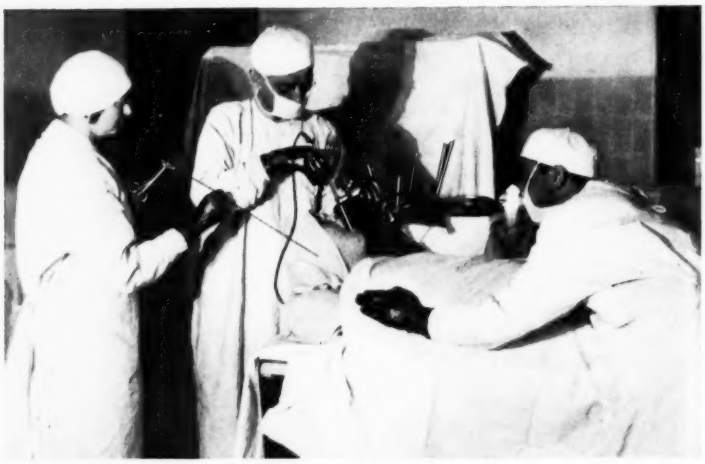

Fig. 7. The operator has insinuated the bronchoscope through the larynx; the distal end is well down in the trachea. He is now ready to remove the heavy laryngoscope leaving the light delicate bronchoscope alone in position. (From advance sheets of *Bronchoscopy and Œsophagoscopy*, by Chevalier Jackson, 2d ed. 1927, W. B. Saunders Co.)

we have the œsophagus pinched together at the hiatus by the crura and the muscular fibers of the diaphragm. The point in the lumen of the œsophagus corresponding to this pinchcock closure is found by lowering the patient's head to the right and aiming the œsophagoscope (or gastroscope) for the anterior superior spine of the left ilium. Gentle but continuous pressure on the proper place will be rewarded after a few moments of patient waiting by the relaxation of the pinchcock. The opening of the hiatal constriction is usually accompanied by a rush of gastric fluid, which will be clear if the stomach is "empty" and normal; otherwise, it may be mixed with pus, blood, or food. Once the hiatus is passed, the œsophagoscope slips so quickly and easily through the abdominal œsophagus that the existence of an abdominal œsophagus is not realized. There is no constriction of any kind, functional or structural, noticed at the cardia, only a faint difference in color and a marked difference in the form of the folds.

If difficulty is experienced at the hiatal or cricopharyngeal pinchcocks, the filiform (*M*, Fig. 1) may be used carefully through the tube by sight to find the lumen; but this is unnecessary and unless very carefully done is unsafe.

Œsophagoscopy in cases of retention. The drainage canal in the œsophagoscope automatically removes all fluid secretions when the tube is held in the handle-up position. If solid foods floating in the fluid clog the inlet at the distal end, it is quickly cleared by detaching the aspirating rubber tube (Fig. 1). Usually all that is necessary is to pass down and rotate a gauze sponge (*R*, Fig. 1). In cases of preventriculosis (so-called cardiospasm), œsophageal lavage with the usual soft rubber apparatus for gastric lavage is generally advisable to remove the often large accumulations of stale food in the upper œsophagus.

Technique of œsophagoscopic removal of a specimen of tissue. The only certain way of making a diagnosis of cancer of the œsophagus early enough to be of any avail is by œsophagoscopy and removal of a specimen. All other methods are inferential and are late at best and often erroneous at worst. To warrant a transthoracic œsophagotomy on a man in the good general condition necessary to survive the major operation requires an absolutely positive diagnosis, and this only the histologist can give. In endo-œsophageal cancer a specimen can be safely taken through the œsophagoscope under guidance of the eye with the long form of the forceps *K*, Figure 1. We have never seen any ill results from taking a specimen of tissue. Obviously it is unwise to penetrate normal œsophageal wall to search for a specimen of periœsophageal cancer. In cases of suspected cancer high in the œsophagus it is well to inspect the hypopharynx and upper end of the œsophagus with the laryngoscope, *A*, Figure 1.

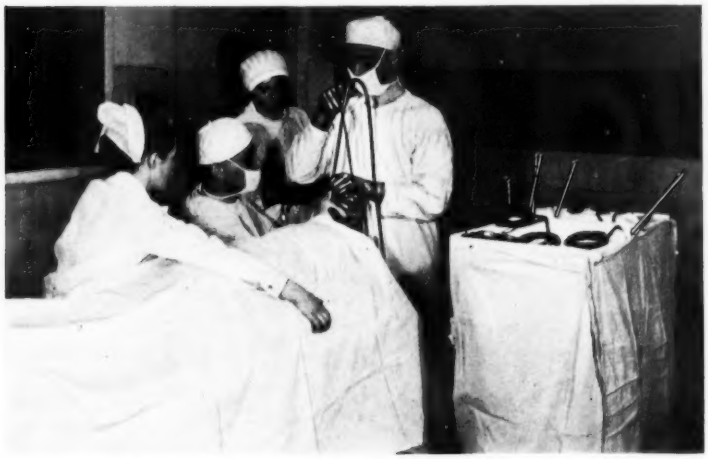

Fig. 8. Œsophagoscopy by the author's "high-low" method. First stage. "High" position. Finding the right pyriform sinus. In this and the second stage the patient's vertex is about 15 centimeters above the level of the table and the operator must be standing. After the œsophagoscopic tube-mouth reaches the mediastinal œsophagus, the head is lowered as required by the operator to follow the lumen as seen through the tube. When the diaphragmatic level is reached the patient's vertex is level with the table top. (From advance sheets of *Bronchoscopy and Œsophagoscopy*, by Chevalier Jackson, 2d ed. 1927, W. B. Saunders Co.)

BRONCHOSCOPIC AND ŒSOPHAGOSCOPIC EXTRACTION OF FOREIGN BODIES

The mechanical problems presented by foreign bodies in the air and food passages are of infinite variety. Some may be pulled out after being grasped by any part first seen, in other cases to do this would be fatal. Study and work with a duplicate of the foreign body in a rubber tube is essential to safety as well as success in cases of safety-pins, staples, pins, needles, tacks, jacks, collar buttons, and in fact almost all foreign bodies. The many problems presented and their solution have been extensively dealt with elsewhere (3, 5, 6, 8, 10, 11, 17).

AFTER CARE

In cases of chronic disease of the œsophagus, no anæsthetic or sedative being used, the patients, adults or children, come in, get on the table and go home or back to work. In chronic suppurative disease of the lung, most patients are kept in bed a large part of every 24 hours as a useful adjunct to medical care. If this is carried out at home the patients come in at the appointed time for bronchoscopic aspiration and return home immediately after treatment. Hospitalized patients rest in bed until the next morning. In patients with slight hæmoptysis, rest in bed is essential. Severe hæmorrhage is a contra-indication to bronchoscopy, except in rare cases in which bronchoscopy is done to arrest bleeding (12).

In very young children, especially in cases of vegetal bronchitis from inspirated peanuts and other nut kernels, beans, peas, watermelon seeds, fruit pits, etc., there is usually as a part of the diffuse laryngotracheobronchitis a swelling of the subglottic tissues. This causes a "croupiness" and in children under 2 years of age the swelling may be so great in a few cases as to require tracheotomy for obstructive laryngeal dyspnœa. For this reason, children are always kept in bed in the hospital after bronchoscopy for 2 or 3 days for observation. In cases of lung suppuration from prolonged sojourn of a foreign body, the patient usually requires no after treatment other than rest in bed under fresh air conditions, and he is usually sent home within a few days after bronchoscopy for this to be carried out under the care of the family physician.

Older children under treatment for suppuration of other than foreign body origin are brought in for bronchoscopic aspiration and are allowed to go home immediately afterward. Not using an anæsthetic, general or local, makes this possible. Nevertheless, for its therapeutic effect, plenty of

rest in bed is essential for chronic pulmonary suppuration under any method of treatment (Pritchard) and rest in bed outdoors is best.

After bronchoscopic pneumonography, we usually keep the patient under observation for a few days, though we have never seen any untoward result. A roentgen-ray examination is usually made after a few weeks to record the disappearance of the bismuth or lipiodol.

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FROM THE SURGICAL CLINIC, UNIVERSITY OF PARIS

HYSTERECTOMY OF THE FUNDUS

By PROF. DR. P. LECÈNE and G. d'ALLAINES, Paris, France

IN 1922, we described under the title of "Hysterectomy of the Fundus" an operation in which the fundus of the uterus and both tubes are removed, and one ovary or at least a considerable part of the normal ovary is left. The guiding principle of the operation is to preserve menstrual function and so avoid the symptoms of premature menopause which generally follow total castration in young women.

In 1895 Zweifel proved by a study of patients operated upon that the preservation of one ovary and a part of the mucous membrane of the body of the uterus is enough to keep up menstruation, and by these observations he opened the way for a new operation in conservative gynecological surgery. Among the surgeons who practiced this operation later and published their results are Werth, Pfannenstiel, Cohn, and Duehrssen in Germany; Kelly in America; Bertino and Spinelli in Italy; and Alban Doran in England. Since 1908 Beuttner of Geneva and his pupils have been particularly interested and have published a number of articles on this method of operation.

But in spite of all these articles, half the surgeons still know very little about hysterectomy of the fundus, although its results are more than encouraging.

According to our opinion and that of the other surgeons cited above, fundal hysterectomy is not intended to replace other conservative methods in gynecological surgery. And it is particularly to be emphasized that unilateral removal of the diseased adnexa and enucleation of fibromata that can be enucleated are excellent operations when the rest of the genital tract is normal, and their justification is proved by the innumerable cases in which pregnancy has followed these operations.

As a matter of fact, fundal hysterectomy is intended for much more extensive lesions. It is indicated in all the anatomical lesions which necessitate the removal of at least the two tubes and a large part of the body of the uterus. In these cases the majority of surgeons perform hysterectomy by the usual methods, and try later to palliate the symptoms of the menopause by glandular opotherapy, a method of treatment which is often ineffectual or at least incomplete.

Other operators have tried to prevent the development of these symptoms by preserving one ovary. This method is being used less and less for it has many disadvantages, such as painful ovary and hæmatocele of the ovary, and besides that it does not prevent the symptoms which it is designed to control.

Experience has shown that in order to prevent these symptoms, menstruation must be kept up. Our observations show that as a general rule the intensity of the climacteric disturbances is inversely proportional to the copiousness of menstruation. By preserving a healthy ovary with a good blood supply and a considerable part of the mucous membrane of the body of the uterus, fundal hysterectomy makes it possible to maintain menstrual function and attain the desired effect.

We will study in succession the indications and contra-indications of the operation, the technique and the end-results.

INDICATIONS AND CONTRA-INDICATIONS OF FUNDAL HYSTERECTOMY

The typical indications for fundal hysterectomy are in our opinion the following:

1. Fibromata of the fundus of the uterus that cannot be enucleated.

2. Severe metrorrhagia due to hæmorrhagic endometritis without inflammatory lesions of the adnexa.

3. Certain more unusual cases such for example as extra-uterine pregnancy with lesions of the tube of the opposite side and an ovary that can be preserved.

In these three kinds of cases the indication for the operation is clear (a) if the woman is young enough to justify the result aimed at (there is little advantage in a conservative operation after 40 years of age); and (b) if there is a healthy ovary and a lower segment of the uterus that can be utilized.

4. Bilateral cystic and adherent adnexitis which resists medical treatment. This is the most frequent indication but it is also the hardest one to establish.

As a matter of fact in the presence of bilateral lesions of the tubes when the uterus appears macroscopically to be healthy, the surgeon is

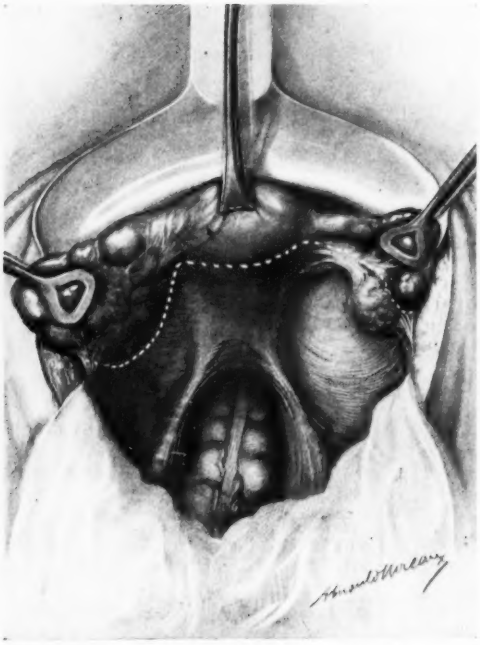

Fig. 1. Tracing of the line of exeresis of the adnexa.

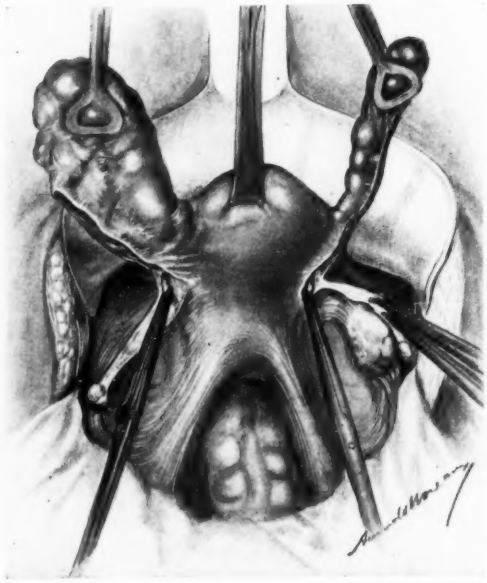

Fig. 2. Hæmostasis of the different vessel pedicles.

tempted to preserve one ovary and the whole uterus. But experience has shown that this is bad practice and it has been almost entirely abandoned. In these cases the fundus of the uterus is always diseased. It is the site of a hyperplastic endometritis which resists treatment and a source of serious trouble after the operation, often necessitating another operation. Therefore it is absolutely necessary in the course of the ablation of the two tubes to remove the fundus of the uterus, which is always affected by inflammation.

Fundal hysterectomy is, therefore, particularly indicated in these cases, for it enables the surgeon to remove the diseased parts freely but still remains a conservative operation.

But it cannot be extended to all cases, for there are very important contra-indications, and if the surgeon overlooks them he runs the risk of serious results.

In practice the indication for the operation depends on two factors: (a) The inflammatory lesions must long since have passed the acute stage and (b) there must be no extensive perisalpingitis or serious changes in the pelvic peritoneum resulting from it. In other words, it must be easy to accomplish complete peritonization. The peritoneum must be supple, mobile, and easy to pull into the desired position.

At the beginning of our use of the operation, which now includes 130 cases, we had 2 deaths, due evidently to the fact that we had exceeded the limits within which the operation is indicated. In these 2 cases the operation was performed for adnexitis with extensive adhesions and active suppuration. The pelvic peritoneum was greatly changed by serious lesions due to perisalpingitis. The two patients died of slow peritonitis.

We think that by limiting the indications for the operation and defining them more accurately, such accidents can be prevented in the future. In our last 40 cases there has been no mortality.

TECHNIQUE

The technique of fundal hysterectomy is simple. We particularly want to give a clear description of what we consider the two essential steps: the hæmostatic suture of the uterus and peritonization.

There is nothing especially difficult about the incision of the wall; it is a vertical, median, or arcuate incision of the Pfannenstiel type.

When the abdomen has been opened, the lesions examined, fundal hysterectomy decided

Fig. 3. Suture of the stump of the uterus.

Fig. 4. Complete suture of the stump of the uterus and the broad ligaments.

upon, and the less affected side (the one on which the ovary is normal) determined, the operation is begun on that side. The fundus of the uterus is caught with forceps and pulled so as to stretch the adnexa of the side on which the ovary is to be left (Fig. 1). On this side it is necessary to respect the upper pedicle of the ovary. The tube is therefore lifted and the vessels at the level of the ovary caught with forceps in the mesosalpinx; two or three pairs of forceps are enough for the securing of hæmostasis which is carried out under control of the eye in the cases in which the mesosalpinx is still transparent. The mesosalpinx is cut above the forceps and the tube freed from the infundibulopelvic ligament to the horn of the uterus (Fig. 1).

On the opposite side the adnexa are removed, as in a subtotal hysterectomy, after any existing adhesions have been freed; but in general if it is possible we think it is preferable to keep the round ligament intact as it may serve for peritonization. In that case incision will be made between the ovary and the ligament as is shown in Figure 2 (left side).

When the two adnexa are freed and remain attached only by their uterine pedicle, a wedge-shaped section of the fundus of the uterus is performed. Before this is done, a pair of forceps is placed on the uterine artery below the plane of section at each side of the uterus.

When should the wedge-shaped excision of the uterus be performed? In Figure 3 we have shown the ideal and most economical section, that advocated by Beuttner and Kelly. The section is wedge-shaped with its base in the fundus and its apex in the cavity. The base is bounded in front by the insertion of the round ligaments. Therefore the most diseased part of the mucous membrane is removed, that is, the fundus, the cornua, and the interstitial part of the tube.

But we think that a more extensive excision can be made. Particularly in the case of a uterus enlarged by metritis with a broadened fundus such a resection would be too economical and would involve the risk of leaving some very badly diseased mucous membrane which would be a source of possible trouble later. So in these cases we practice a cuneiform resection which removes all the fundus of the uterus including the insertion of the round ligament but leaving intact a segment of the uterus at least 3 centimeters high above the isthmus.

Hæmostasis of the large vessels being assured by ligature, the uterus is sutured (Fig. 4). This

Fig. 5. Complete peritonization with supravesical and retrovesical peritoneum.

Fig. 6. Diagram showing the different stages of the sutures at the end of the operation.

suture is a very important step for it accomplishes hæmostasis by bringing together the walls of the uterus which sometimes bleed copiously, especially in the case of a very œdematous uterus. This step should be executed with the greatest care, for postoperative hæmorrhage may be a source of very serious danger. One of our patients died after the operation from subperitoneal and intrapelvic hæmorrhage. One of us saw a case of pelvic hæmatoma which necessitated an incision for evacuation.

The walls of the uterus must be brought together very carefully, first by a row of large interrupted catgut sutures which include the whole of the wall of the uterus on each side; these must be reinforced by an overcast hæmostatic suture of catgut. At the end of this step the line of suture should be absolutely free of blood; if there is even the slightest oozing of blood at any point, a few reinforcing sutures should be added.

We now come to the peritonization which is one of the essential steps in the operation. The stump of the uterus cannot be peritonized with the uterine peritoneum alone, as at this level it is adherent to the body of the uterus down to the isthmus and cannot be pulled or folded. Peritonization, therefore, should be accomplished only by means of the pre-uterine peritoneum, (the inter-utero-vesical peritoneum) which is mobile and very easy to pull backward.

The peritonization of the lateral parts does not present any special difficulty. On the side where the ovary has been left, the suture of the peritoneum passes in front of it, leaving it completely intraperitoneal. It is not necessary to bury the ovary in the new broad ligament. This position, aside from the fact that it does not correspond at all to normal anatomy, might cause trouble later, such as particularly intense pain at the menstrual period.

The peritonization of the line of suture of the uterus is more important. When the overcast stitch of the peritonization reaches the lateral angle of the stump of the uterus it is passed as follows: The needle first catches the peritoneum of the posterior surface of the uterus well back of the section, then it is passed into the retrovesical peritoneum just back of the bladder at the place where the peritoneum is very mobile and easy to pull backward. A rather large fold is lifted up at this point with a dissecting forceps and the suture passed into it. The first stitch sometimes has to be made in two stages because the distance that separates the two surfaces of peritoneum which are to be brought together is so great; but once the first stitch is brought together the retrovesical peritoneum caps the uterus spontaneously and the other stitches can be passed at one step and very easily.

When the opposite angle of the uterus is reached, the suture is continued, simply peritonizing the ligatures of the broad ligament with the round ligament and the infundibulopelvic ligament which has previously been ligated.

When the suture is finished, the retrovesical peritoneum covers the stump of the uterus like a hood. The rest of the operative technique does not present any special features. Abdominal drainage is of course possible. We have used it very rarely for we are coming more and more to use this operation only in non-infected lesions.

RESULTS

Immediate results. We have reported 2 cases of postoperative death. We think, as we have said above, that in order to keep for fundal hysterectomy that benignant character which all conservative operations ought to have as a matter of principle, its indications should not be extended too much. And the most painstaking care should be exercised to attain an absolutely perfect hæmostasis. If these rules are observed the surgeon will find that the results of the operation are very good and convalescence uneventful.

Late results. Among our 130 operations, hysterectomy had to be performed later in 2 cases. We have not been able to obtain exact details in regard to 1 of these patients. The other had a genital tuberculosis, and in this disease we do not think conservative operations are indicated. We have seen 72 of our patients from 1 to 6 years after the operation.

We examined the organs left in place systematically in all of them and studied menstruation and the possible symptoms of premature menopause.

CONCLUSIONS

1. *Condition of the pelvic organs.* Bimanual examination after fundal hysterectomy shows a normal cervix and a small, mobile, and painless body in anteversion. It is unusual to find a metritic discharge (4 cases out of 72). This metritis, localized in the cervix, is easily treated. The remaining ovary is generally painless. It is frequently large and can be felt on palpation in the cul-de-sac. Very rarely it is the site of vague and not very serious pain at the time of menstruation. Bladder function is absolutely normal.

2. *The menstrual function.* All the patients whom we have seen continued to menstruate after the operation. Two patients, aged 42 and 47, had already reached the normal menopause and no longer menstruated. We have said above that after 40 years of age the benefit derived from fundal hysterectomy is not very great. In the great majority of cases the menstruation was less copious than before. It is painless. Only 5 patients complained of some menstrual pain and they had had pain before the operation.

3. *Symptoms of the menopause.* In our series, 90 per cent did not show any symptoms of the menopause after the operation, such as flashes of heat, obesity, and changes of disposition. Only 6 patients complained of symptoms: flashes of heat, slight increase in weight, fatigue, etc., some of them at the time of menstruation, some of them continuously. These symptoms were slight enough so that they did not interfere in any way with the patient's work.

SUMMARY

1. Fundal hysterectomy makes it possible to preserve menstruation and avoid to a very great extent the symptoms of a premature menopause.

2. The operation is indicated if the woman is young enough (less than 40) and it is possible to preserve a healthy ovary and a part of the body of the uterus.

3. The operation is contra-indicated if the lesions have not long since passed the acute stage and if the pelvic peritoneum has been changed by serious adhesions or suppurative perisalpingitis.

4. Hæmostasis and perfect peritonization are the essential steps of the operation and they must be effected with the greatest skill.

5. The mortality of the operation is low (2 cases in 130), and it can be lowered still more by a better choice of cases.

"BASEBALL COVER FLAPS" IN LEG AND THIGH AMPUTATIONS

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From the Department of Surgery, University of Kansas

TO produce a smooth stump with properly placed scar is the aim of every surgeon doing an amputation when an artificial limb is to be worn.

The technique of flap making here illustrated enables the operator to close the wound without the troublesome redundant skin so common in other flaps. Properly made flaps avoid skin puckering. Ill fitting flaps produce irregularities and pockets which are easily irritated by artificial limb sockets.

Fig. 1. Lines of incision for "baseball cover flaps."

In every finished amputation of the lower extremity, the muscles should be grouped about the end of the bone. This not only gives the right shape for flap fitting but properly places the cut ends of the muscles for healing with new insertions at the stump end. When the muscles heal with proper insertions the future function of the stump is assured, insofar as motion is concerned.

The method of making the incisions for the "baseball cover flaps" is shown in Figure 1. The old rule of making the sum of the length of the flaps equal to one and one-half times the diameter of the extremity applies here. The measurements should be made from the site selected for the bone section. This is easily and accurately done with a piece of catgut or other suture material by taking half of the circumference which is the length desired for the sum of the two flaps, being approximately one and one-half times the diameter of the extremity. Flaps of equal width can also be estimated by measuring the circumference and making the flaps one-half the circumference in width.

Care should be exercised not to make the long anterior flap too narrow at the base and thus interfere with the blood supply. The posterior flap should be short and not dissected from the muscle except for a sufficient distance to enable easy suturing to the anterior flap. In all cases the deep fascia should be raised with the skin flap. Separation of the skin and deep fascia only disturbs the circulation of both and can serve no good purpose. The deep fascia should always be carefully closed since it is the normal envelope of the muscles and aids in making a smooth stump by avoiding adhesions between the skin and the muscle.

Fig. 2. Lateral view after closure of flaps.

Fig. 3. Posterior view of stump with anterior flap sutured in place.

When the anterior flap is brought over a well-rounded stump end, it will fit accurately into the short posterior flap (Figs. 2 and 3).

The "baseball cover flap" can be successfully used in all cases in which sufficient skin for such flaps is available, no active infection is present, and the circulation is not greatly impaired.

THE TECHNIQUE OF THE SURGERY OF THE GASTRO-INTESTINAL TRACT

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A DISCONTENT with things as they are and a constant effort to make things better constitute the basic drive in the human soul which has resulted throughout the centuries in our present form of civilization. It is perhaps but natural that this urge more often takes the form of a search for the new, the untried, the glittering will o' the wisp floating just ahead, than that it should assume the burden of a patient, consistent effort to improve the already known, to increase the efficiency of long accepted procedures.

In the field of surgery this search for the new, this unquestioning acceptance of the old, seems particularly striking. We have all seen ventures into new fields heralded as the harbingers of a new era in surgery, ventures which perhaps bring temporary fame and prosperity to the originator yet which have wrought no permanent change in the stream of surgical affairs. The real progress of surgery has always depended upon the workers who have added a little here and a little there to the diagnosis and treatment of everyday pathology.

The technical methods of those surgical procedures which have survived the test of daily practice have been simple methods; they are such that the surgeon of average ability can master them. This is because the instruments and the materials with which the surgeon works are simple—a knife, scissors, a needle, and some kind of thread—used with a material which does not lend itself as readily to fine sewing as does a bit of cambric, and the methods must remain simple and comparatively coarse. This is not a criticism of surgery, for the nature of the material with which the surgeon works, the tissues of the human body, cannot be changed. We have to go no further afield than to the art of dentistry to find an instrumentarium far surpassing in delicacy that of the surgeon, and an array of materials, rubber, pure metals, alloys, amalgams, cements, etc., requiring a mechanical technique far more exacting than that needed by the surgeon.

This technical simplicity of surgery does not mean that operative procedures *must* be kept simple in order that the average surgeon may master them, as we often hear. It means that the procedures that stand up under the test of everyday use will necessarily be simple, because of this simplicity of tools and materials which characterizes the technique of surgery.

If surgery is to progress, in what direction? We believe that the future of surgery will be marked by improvement in the details of existing procedures, rather than in the discovery of new methods or the opening of new fields for surgery. The greatest advance will lie along the line of the earlier diagnosis of disease, the development of preventive surgery; as, for example, the development of the precancerous surgery of the breast in place of the present attempt to snatch back the woman with one foot already in the grave.

Another field for advancement seems open, to cultivate the art of the watchmaker, to develop an eye and a hand which can lay three stitches where but one will go at first; in other words, to refine our present methods. In order to attain the refinement of technique there must come first a true understanding of the materials with which we are working; a true measure of physiological and surgical values; an understanding of the function, not of organs as a whole, but of their component tissues. The function of each component must be understood since the function of the whole is but the sum of the functions of the component parts, and the restoration of function is the prime object of all surgery; but also the mechanical possibilities of each component tissue must be understood so that it can be treated to the best mechanical advantage.

With this general idea in mind it seemed that it might be worth the effort to consider the problem of the technique of the surgery of the gastro-intestinal tract, to analyze the material available and the objects sought in each step of the operation and the means best suited for attaining that object with the material at hand; for the principles of the operation of opening and closing an infected cavity within the peritoneal space are basic to all intraperitoneal operations. A careful study of the reactions of men trained in different schools of medicine, men who have as undergraduates followed different textbooks of surgery, leads to the inevitable conclusion that few, if any, have even thought of the reasons why each step of an operation is done as it is done, and what the object of each step is, or if it might be accomplished better by some different technique.

It seems to be a new thought to most men, yet the thought is basic to all true pedagogic principle, that the technique of the master should be copied, not because it is the way the master does it, but for the same reason that led the master to adopt that technique. The result may be the same, the student learns the master's technique, but with the vast difference that in the one instance he is but a mimic; in the other instance he has grasped the reasoning, the mental workings of the master's mind. And when the occasion arises in which the student is confronted by a new problem he will reason it out as the master would have done; he has become a true disciple.

The considerations which I wish to present are the result of an attempt to teach to would-be-surgeons, both undergraduates and graduates in medicine, the principles of intraperitoneal surgery. To this end we have used the operation of end-to-end anastomosis of the small intestine, for it has seemed that the fundamental principles can best be taught in the consideration of this one operation. The same principles apply to the entire gastro-intestinal tract, whether stomach, small intestine, or large intestine, whether lateral or end-to-end anastomosis. Perhaps some of the much discussed problems as to whether an end-to-end or a lateral anastomosis is to be preferred can be solved if we understand the principles involved. The conclusions which I here present are the gradual product of 18 years of such teaching, with much experiment and trial of different ideas.

There have been some 250 methods devised (DaCosta). Would it be presumptuous to assert that the reason for this multiplicity of suggestion is because the basic principles have not been grasped? Certain it is that the reasoning that led to some of these suggestions was wrong; certain it is that the teaching found in our most modern textbooks is wrong; certain it is that the most recent discussions and suggestions to be found in the literature, within the past few years (5, 6, 10, 11, 12, 20, 23, 26), do not even hint at the vital considerations; and I have not found in the literature a complete analysis of the physiology and the mechanical values of the component structures of the intestinal wall.

Let us look at the material with which we are to work, first from the anatomical and physiological side, and then consider this material from the standpoint of surgical technique.

The intestine is composed of a series of tubes drawn one over the other. On the outside there is a tube of peritoneum or serous membrane. Perhaps it is, strictly speaking, not a tube, for it is incomplete, there being a V-shaped space along the attachment of the mesentery, within which lie the blood vessels, lymphatics, and nerve trunks, and at the top of which is a portion of the intestinal wall which has no covering of serous membrane. This area will therefore require a surgical treatment different from that required by the rest of the surface, to which point we will return later.

"The peritoneum, the serous membrane lining the abdominal cavity and covering more or less completely the therein contained organs, consists of a connective tissue stroma and the surface layer of mesothelium" (15). . . . "The young mesodermic cells bordering the early body cavity become differentiated into a delicate lining for this space, and later give rise to the plate-like elements which constitute the lining of the permanent serous sacs. The primary lining is known as the mesothelium, which name is often retained to designate the investment of the pericardial, pleural, and peritoneal cavities, as distinguished from the endothelium which lines the vascular and other serous spaces" (16) . . . "The latter" (the mesothelium) "is a single layer of plate-like cells irregularly polygonal in form and of varying size, whose contours are mapped out, after staining with silver nitrate, by delicate, sinuous, dark lines that correspond with the particles of reduced silver in the intercellular cement substance. Each cell encloses a flattened nucleus, usually somewhat eccentrically placed, that is almost invisible until tinged with some appropriate dye" (Fig. 1). "The size and form of the mesothelial plates vary much with the tension to which they are subjected; when unduly stretched, they are often imperfect, or, indeed, displaced.

"The stroma consists of a felt-work of connective tissue bundles of variable fineness, those of the parietal being commonly more robust than those of the visceral peritoneum . . . This fibro-elastic layer varies in thickness, but in many places, as over the liver, stomach, or intestines, where the peritoneum is intimately attached, the sub-serous tissue is so reduced as to be practically wanting" (17).

This is a consideration of the serous membrane as seen from the surface. Suppose we examine it in cross section of the intestinal wall. We will find these mesothelial cells as very thin lines, with the nucleus bulging outward, the entire cell at its thickest point, through the nucleus, being of no greater thickness than the diameter of the red blood cell. If we are looking at a piece of intestine where there is some connective tissue stroma we may see a structure which we could call a serous membrane of perhaps three times the thickness

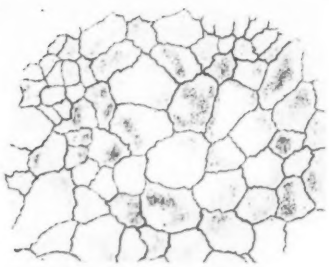

Fig. 1. Mesothelial cells from surface of omentum; intracellular cement substance stained by argentic nitrate. ×300. (From Piersol, 15.)

of the mesothelial cell, possibly 25 micra or 25 thousandths of a millimeter in width. If we place the diameter of the smallest particle visible to the naked eye at 50 micra, then we have a serous covering of the intestinal tube one-half as thick as the smallest visible thing, containing on the outside delicate cells; and, in addition, the entire structure is transparent.

Is it not, then, proper to suggest that we cease talking of a seroserous stitch in gastro-intestinal surgery? Does not the consideration of the delicate, intangible, invisible structure before us indicate that we should cease the comparison with a cow's teat, in the suggestion that we "milk the contents of the intestine away from the field"?

The physiological value of the serous membrane consists in its function of offering a smooth surface, further made slippery by the secretion or activity of these mesothelial cells so that the organs may slide freely over one another.

The surgical value of the serous membrane is paramount, and consists in two properties possessed by it; the first is that when two surfaces covered by mesothelium are pressed together, the mesothelial cells disappear, the underlying fibrous components of the stroma grow together, or, as some think, the mesothelial cells, themselves, transform into fibrous tissue, and the surfaces become firmly united. It is by such a process that the mesenteries form; the original peritoneal covering of the posterior portion of the body of the pancreas disappears; that surgical wounds heal, and that adhesions, the undesired result of abdominal surgery, arise.

The second property possessed by this membrane which is of value to the surgeon is its power to resist infection. A suppurating wound of the abdominal wall may extend to the peritoneum, but will be stopped there; the infection accompanying all intestinal operations is disposed of by this property of the mesothelial cells. The exact

Fig. 2. Involuntary muscle from intestine; several isolated fiber cells are seen below. ×200. (From Piersol.)

mechanism by which the mesothelium accomplishes this function is an unfinished problem; that the mesothelial cells can act as phagocytes is known. The lack of serous membrane over that portion of the intestinal tube lying within the V of the mesenteric attachment makes this portion especially difficult surgically, and compels especial care and attention to this point. Infection occurring here, really extraperitoneal, may gain such headway that it can break through and invade the peritoneal cavity in so great a mass as to overpower the resisting property of the mesothelial cells.

The problem confronting the surgeon becomes one of handling a structure he cannot see by the aid of structures he can see and handle. The things he must not do are more evident than the things he must do. He must avoid all injury to these delicate cells; clamps, sponges, if used at all, must be used with an appreciation of the delicacy of the cell covering of the intestine. Salt solutions must be made isotonic with these cells. It is poor practice to expose more than is absolutely necessary to the drying effect of the air, particularly the hot air of a surgical clinic.

The serous membrane covering the intestine is like the mind of a child, delicate, invisible, intangible, a thing which must be treated with all gentleness, protected from all sorts of harmful agents, directed into the paths in which we would have it go by the moulding influences of gentle pressure, not to be pulled and hauled and scraped; else the seeds of infection will take deep root, and, at best, it will attach firmly to things over which it should normally slip.

Immediately below this incomplete tube of serous membrane is a complete tube of longitudinally arranged muscle cells. "Nonstriated, smooth, pale, unstriped, or involuntary muscle, as it is variously designated, consists of structural units known as the fiber cells. These are delicate spindle, often prismatic elements, whose tapering ends fit between the adjacent fiber cells.

"The individual fiber cells (Fig. 2) are held together by an exceedingly delicate investment of connective tissue fibers, both white and elastic, which surround the muscle elements, and in cross sections appear as lines, formerly interpreted as

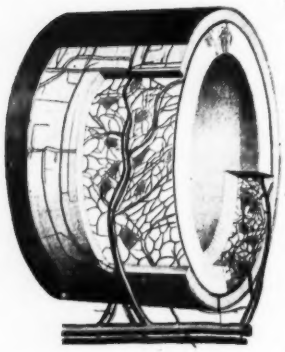

Fig. 3. Showing how the blood vessels lie upon and within the submucosa. (From Mall, 13.)

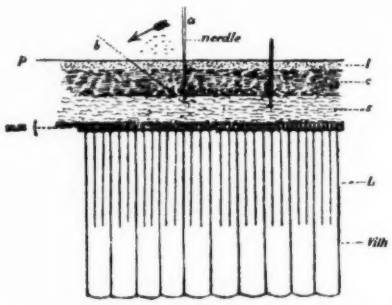

Fig. 4. Photograph of the drawing by Mall, published by Halsted (8, 9). An actual needle was laid upon the picture before photographing. This to emphasize that in Mall's drawing a needle smaller than an actual needle has been drawn into a representation of the intestinal wall enlarged to 5 centimeters in width.

cement substance, that pass between and around the fiber cells" (18).

Beneath this tube lies a thicker tube of involuntary muscle cells arranged circularly. It is made up of the same elements as the longitudinal muscle bundle, but is a larger structure. A stitch laid through this coat has a certain holding power; yet I find that it is only with the utmost care that stitches can be laid using all three of the intestinal coats thus far considered. These three layers together have so little fibrous tissue in their structure that stitches in them alone can act only as approximating stitches; and even so they cannot be drawn tightly enough to secure a dependable approximation.

Underneath this tube of circular muscle lies a tube of connective tissue, of the type called "loose fibrous" or "areolar tissue," constituting the real foundation structure of the intestinal wall.

"Loose fibrous or areolar tissue occurs throughout the body wherever the opposed parts, although connected, enjoy considerable mobility. Familiar examples are the sheets or tracts of yielding connective tissue, which lie between the skin and underlying fascia, or beneath mucous membranes, that unite the muscles, and assist in keeping the viscera in place. The variable bundles of white fibers are loosely and irregularly disposed, crossing in all directions, and enclosing correspondingly indefinite lymphatic clefts. The elastic fibers form a network of highly refracting threads, which, in sections and teased preparations, are more or less wavy and curled" (19).

There is very little elastic tissue in the intestinal wall; the stretching of the wall is accomplished more because of the interlacing direction of the fibers than by means of a direct stretching of elastic elements.

This layer is called the submucosa (Fig. 3); it is the foundation about which the entire organ is built. On the inside it supports the essential functional element, the mucosa; on the outside it carries the muscle tubes by means of which the contents can be propelled along the surface of the mucosa. It offers within itself a support for the bloodvessels and lymphatics (13). It is a tough, though thin membrane, giving to the intestinal wall almost all of its strength. This strength is quite considerable; we have found that the intestine of a dog can resist a bursting pressure of 17 pounds; section of the mucosa down to this submucosa does not diminish this strength; likewise, section of the muscular coat makes but little difference in the pressure required to cause bursting. In fact, when a section of fresh intestine is blown up, the muscle layers may be seen to exhibit long tears extending all the way to the submucosa, long before the bursting point of the submucosa is reached. This tube constitutes the sausage casing of commerce.

Anatomically and physiologically this submucosa is simple in its properties. It is only a foundation upon which the other all-important layers are supported. Surgically, it is the one component of the intestinal wall possessing mechanical properties which can be utilized. It is the only part of the wall which is resistant to the pull of a stitch. This was recognized long ago by Halsted (8), and his teaching has been commonly introduced into our textbooks; we believe that a part of this teaching is erroneous, and will return to the subject later.

For the moment let us emphasize this point: just as this submucosa constitutes the support work, the structural steel-work upon which all

Fig. 5. Photomicrograph of a section from the middle portion of the small intestine of the human being, together with the end of a needle, a bit of No. 00 catgut, of No. 4 silk, and of a human hair. The intestine was fixed and hardened in the usual manner.

the rest of the building hangs, in the normal intestine, so must the surgeon repair it as a framework, giving it the necessary strength at the line of repair to carry this burden of support until complete healing has brought complete restoration.

Within this supporting tube are three further tubes, a muscularis mucosæ, a stratum fibrosum, or a sort of basement membrane for the mucous membrane, and the mucosa itself. The purpose of the muscularis mucosæ is to throw the mucous membrane into folds, perhaps actually to move the mucous membrane so that fresh surfaces are brought into contact with the food. It is a delicate affair, sometimes two cells thick, not always a complete tube. Yet we find one of the best books on the subject of gastro-intestinal surgery stating at the outset—"the muscularis mucosæ achieves its great importance from its tough structure, which is peculiarly adapted to resist the pull of a stitch. It is the only portion of the intestinal wall which has this valuable quality" (7). It perhaps matters little, but this statement is not true. I quote merely to show that even those who have worked especially along this line have not always been clear as to what they were doing.

The so-called "stratum fibrosum" is a connective tissue tube upon which the cells of the mucous membrane are arranged. Like the muscularis mucosæ it is too delicate to possess any physical characteristics which can be made use of by the surgeon.

The innermost tube of these several tubes of which I conceive the intestinal wall to be composed, is the mucous membrane. Anatomically, it is a row of high columnar epithelial cells, one row deep; the total surface area is greatly increased by the folding of the membrane, and by

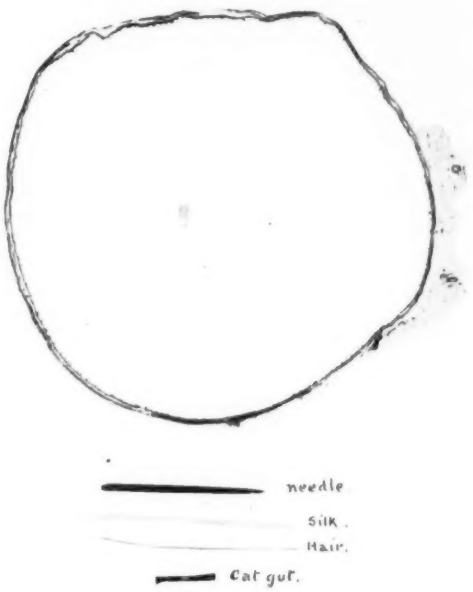

Fig. 6. A piece of the same intestine as in Figure 5, fixed and hardened after filling the lumen with the fixing solution. Beside it a needle point, a bit of Catgut No. 00, of silk No. 4, and of a human hair.

the numerous finger-like projections or villi, which stand out on the inner aspect of the intestine so thickly as to give the characteristic velvety appearance, that is, when the intestine is not dilated but is in the normal semicontracted state.

Physiologically, the mucous membrane is all important; it is the portion which all other parts must serve; it is the excuse for the existence of the entire organ; but from the standpoint of surgical mechanics it is of no use, for it has no strength; it can be picked off with forceps, and even considering the fibrous base and the muscularis mucosæ as a part of the mucous membrane, we still do not have a structure capable of resisting the pull of a stitch.

The suture of the mucous membrane is therefore an impossible concept; should we still teach it (5)?

From the standpoint of surgical mechanics the mucous membrane is of no use; better be it said, it is worse than useless, for this tube of mucous membrane communicates directly with the outside world. In fact, I like to think of the intestine as containing another tube within the mucous

membrane, a tube of infection, varying in its character, but never lacking. And this infection is not only on the surface, but extends down between the villi, into the crypts, and doubtless farther into the mouths of the glands of the intestine, which glands lie beneath the muscularis mucosæ, within the submucosa. It, therefore, seems idle to assert that one can lay a stitch through all the coats but the mucosa (22).

The surgeon is therefore confronted with the problem of dealing with two delicate, invisible, intangible tubes, an outer tube of delicate mesothelial cells, absolutely necessary to his purposes; and an inner tube of infectious material which he must avoid, which is so intangible, that if the point of his needle but touches it, the infection will follow his thread wherever it may go. Between these tubes there is a very definite, very resistant structure, which he can see and feel and sew; as this submucosa is the framework of the intestine, so must the surgeon make it the framework of his repair.

How can the surgeon save peritoneum and avoid mucosa, that is, infection? This is the problem of intraperitoneal surgery.

If we turn to the textbooks, the answer appears simple; the needle is to be simply inserted into the submucosa, but must not go all the way through this layer. Thus a sufficient "bite" will be obtained in a tissue tough enough to hold the pull of the stitch, yet the needle and thread will not be infected by contact with this invisible, intangible inner tube of infection of which I have spoken. Such is the teaching in the majority of textbooks. It is based upon the work of the late Professor Halsted of Baltimore who was the first to call attention to the finer anatomy of the intestinal wall, and to the importance of a knowledge of this finer structure to surgery (8).

While, therefore, I cannot claim the honor of being the first to discuss the surgery of the gastrointestinal tract from this point of view, I nevertheless feel entirely justified in a re-presentation of the subject; for it appears to me that Halsted overshot the mark in his conclusions, so that, while the textbooks copy his conclusions, the practical surgeon soon realizes the incorrectness of the teaching and therefore, perhaps, tends to react away from that which is correct.

"Before describing my experiments," writes Halsted (8), "I wish to call attention to certain points relating to the anatomy of the intestinal wall, a knowledge of which is of the utmost importance to the surgeon who performs intestinal sutures. In looking through the literature of intestinal suture, I cannot find that anyone has called sufficient attention, from a surgical point of view, to the structure of the different coats of the intestine, particularly to their physical properties. Indeed, the descriptions in surgical textbooks, as well as in monographs and articles treating especially of intestinal suture, and the drawings which are frequently inserted to elucidate the subject, lead me to believe that the current ideas among surgeons are not only incomplete, but absolutely incorrect as regards some important details in the structure of the intestinal coats. If these errors related to matters of only histological interest their practical bearing would be very slight, but my experiments have led me to attach great weight, in the successful performance of enterorrhaphy, to an accurate knowledge of the thickness and physical characters of the submucous coat of the intestine, and I am not aware that the importance of this coat in connection with this operation has hitherto been emphasized.

"The old views of Jobert and Lembert as to the structure of the intestinal wall seem to have been adopted by modern surgeons with little or no modification. The peritoneal coat, for instance, is believed to be thick enough and sufficiently strong to hold a stitch, and the existence of the submucosa, for us the important coat, has been generally ignored."

All of which is, as I see it, eminently true, and nearly as true today (5) in regard to the understanding by the surgeon of the true state of affairs,—especially by the young surgeon, just starting out to make a name by the usual route, the invention of a new method of intestinal anastomosis,—as when Halsted wrote the above words; or as when, a few years later, he wrote (9): "About three years ago I endeavored to emphasize the importance of the submucous coat in operations upon the intestine, but only succeeded in attracting attention to the quilt or square stitch which I still employ in all sutures of the intestine."

In his earlier paper Halsted goes on to say (8): "Fig. 1, kindly drawn for me by Dr. Mall, is a diagram of the wall of the dog's intestine, and is intended to represent accurately the relative thickness of the several coats. The serosa is prolonged beyond the outer muscular coat to emphasize its thinness. Between the submucosa and glands of Lieberkuehn—in other words, between it and the lumen of the intestine—practically nothing intervenes; and, literally, nothing but the two layers of muscularis mucosæ and fibrosa mucosæ respectively. Fully two-thirds of the thickness of the wall of the intestine is mucous

membrane. When the needle, therefore, has been passed through its outer third it must have entered the glands of Lieberkuehn, and, hence, the lumen of the gut. It is an easy matter to isolate the submucosa. The outer muscular coats strip from it readily, and the mucous membrane can be rapidly scraped off with a knife. Thus obtained, the submucosa is found to be an exceedingly tough, fibrous membrane. It is air tight and water tight, and is the "skin" in which sausage meat is stuffed. It is, moreover, the coat of the intestine from which catgut is made."

And now we come to the place where Halsted overshot the mark: "A needle, on being pushed vertically through the wall of the intestine, meets with considerable resistance when it reaches the submucosa; and still greater resistance is encountered if it be attempted to pass the needle horizontally through its meshes. A delicate thread of this tissue is very much stronger and better able to hold a stitch than is a coarse shred of the entire thickness of the muscular and serous coats. Upon the discovery of the latter fact, at which I was, perhaps, as much surprised as most surgeons will be at the statement of it, it naturally occurred to me that it would, if feasible, be well to include a portion of the submucosa in the suture . . . I soon discovered that, even to the sharpened end of a needle, sufficient resistance is offered by the submucosa to be easily appreciable, and that it is possible and, with very little practice, not difficult to pick up at each stitch a thread-like piece of submucosa without incurring the danger of passing into the lumen of the gut."

In the report (9) of a demonstration before the Johns Hopkins Medical Society, December 1, 1890, Halsted republishes the drawing we here reproduce (Fig. 4); he evidently successfully demonstrated that a stitch could be laid (in the intestine of a dog) as he describes, and he drew the following conclusions:

"For the performing of an intestinal suture of any kind I would emphasize the following statements:

"1. It is bad surgery to employ a stitch which enters the lumen of the intestine.

"2. It is impossible to suture the serosa alone.

"3. It is impossible to suture unfailingly the serosa and muscularis alone unless one is familiar with the resistance offered to the needle by the coats of the intestine. Furthermore, stitches which include nothing but these two coats tear out easily and are, therefore, not to be trusted.

"4. Each stitch should include a bit of the submucosa. A thread of this coat is much stronger than a shred of the entire thickness of the serosa and muscularis. It is not difficult to familiarize one's self with the resistance furnished by the submucosa, and it is quite as easy to include a bit of this coat in each stitch as to suture the serosa and the muscularis alone."

The trouble with all this can be seen in the picture. One cannot criticize the anatomical part of a drawing made by an anatomist so eminent as was Dr. Mall. The anatomical relationships are doubtless correct,—but the needle was drawn in by a poet. In regard to this drawing, Halsted writes (8): "The peritoneum is so thin that one cannot represent it by the finest pencil stroke unless the wall of the intestine be magnified to a thickness of about 5 centimeters (vid. Fig. 1)." On this manifold magnification of the intestinal wall has been drawn an extremely fine needle in its natural size or even smaller; in fact, I would welcome the finding of needles made with points as fine as this. I have placed on the picture before photographing it a needle of the actual size recommended by Halsted.

Suppose we attempt a comparative representation of the facts in the case, by making a photomicrograph of an actual section of the human intestinal wall, with a needle, a silk thread, a piece of catgut, and a bit of a human hair laid beneath the cover glass, equally magnified with the intestinal wall. And suppose we do this under two conditions; a piece of gut fixed in the collapsed contracted state, and a piece of the same gut, filled with a fixing fluid during the hardening process; let it be distinctly understood that this second piece of gut is not dilated, simply filled.

The needles in the photographs, or, strictly speaking, the needle points, since only a portion of a needle could be included, are the finest obtainable from the operating room of one of our large hospitals; the silk is No. 4, the catgut No. 00 iodized. Finer materials can be obtained, but these are the finest to be found in the operating room of this hospital, and apparently represent the finest practical materials in the opinion of the practical surgeons who use them. For the sake of the visual comparison, I have placed in the photographs a bit of a human hair, which is the finest suture material, practical or impractical, with which I am acquainted. It is, of course, true that these tissues have shrunk somewhat in the processes of fixation and hardening preparatory to sectioning. This shrinkage is believed by histologists to amount to less than one-half the original thickness of such tissue as the gut wall (Figs. 5 and 6).

A study of these comparative values, and many experiments, have convinced me that, whether it

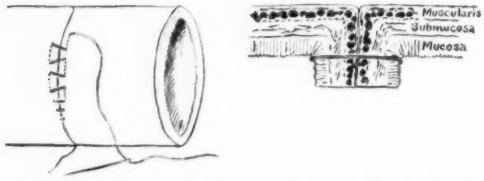

Fig. 7. The manner of laying a Cushing stitch, showing the area of potential infection (shaded) carried by the suture, and how it is covered in as the stitch is pulled taut. In cross section, the course of the stitch through the walls.

be bad surgery or not to penetrate the intestinal lumen, it is done in the great majority of intestinal stitches, even when one is trying to avoid penetration of the lumen. I personally cannot lay a stitch in the dog's intestine into the submucosa without penetrating the deeper layers of the mucosa; and I am convinced that unless the submucosa be caught in the stitch the suture is unreliable and cannot even be pulled tightly enough to insure good approximation and certain hæmostasis.

A study of Halsted's work makes one wonder just how often he himself succeeded in picking up only a thread of the submucosa. In some of the remarkable descriptions of the work of his school (14), penetrating stitches were found. Writing of his 35 years of work on this subject, Halsted says (11): ". . . it is possible, at least in experiments upon the dog, to have another constant factor,—viz., the depth to which the stitches penetrate." Here we see what appears to be a qualification in Halsted's own mind of the extent of the applicability of his teaching to species other than the dog. The consideration is important, that the intestine of the dog differs from the human intestine, and we must always bear in mind that the experiment on the animal has no object except as the results be applicable to the human being.

Again, in discussing a method called "A bulkhead suture of the intestine," Halsted wrote (10): "Advantages of the method: 1. It is aseptic, except as contamination may occur from the stitches, which, of necessity or by accident, have been carried into the lumen of the intestine."

Our own futile attempts to accomplish this laying of a suture into, but not through, the submucosa lead us to the conclusion reached by all practical surgeons but expressed by but few. We agree entirely with Binnie (1):

"Lembert's suture:—This is the basis of almost all methods of intestinal suture. Its aim is to close an intestinal wound by turning the cut edges inward and bringing the serosa of one side into apposition with that of the other side. Halsted has shown that it is wise to include the submucosa in the stitch. When a *not* too sharp needle is introduced through the serosa and the musculosa, its advance is easy, but when it reaches the submucosa, a slightly increased resistance is perceptible. It is said to be easy to pick up some of the submucosa on the point of a needle without penetrating the mucosa. The author has frequently endeavored to insert Lembert sutures involving the serosa and musculosa alone, but they always tore out; the picking up of a few fibers of the submucosa without letting the needle pass into the mucosa seems to be an 'iridescent dream'; if anyone doubts this, let him try to sew two sausages together without touching the contained meat with the thread (sausage casings consist of the submucous coat of the gut). The blood vessels lie in the submucosa, and in suturing, unless the thread is passed under the vessels (i. e., nearer the mucosa) the stitches will exercise no pressure upon them, and thus serious hæmorrhage may and sometimes does occur. In inserting sutures, the surgeon should see to it that each stitch embraces firm tissue and will not cut out and that each stitch goes under any visible vessel in its track. If these two rules are observed good results will be obtained no matter if the thread does pass through the deeper layers of the mucosa. The author knows of one or more cases in which the operator took special pains to insert the sutures through the serosa and musculosa alone and nearly lost the patient from hæmorrhage."

These facts are known to all, perhaps (5), yet have not seeped into the pages of most of our textbooks. Thus Connell states (4): "Because of the relative size of the needle and the submucosa, any stitch which includes part of the submucosa must perforate into the lumen. If it does not include the submucosa, the stitch is unreliable, because insecure. The stitches which penetrate the submucosa are the weak point, from an aseptic standpoint, but are the strong part of the operation from the standpoint of security."

Or, as I have often expressed my belief to my students, I suspect that more patients have been killed by sutures which did not penetrate the mucosa than have been killed by penetrating stitches.

If we now agree that the submucosa is the only dependable layer, surgically, of the intestinal wall, and further that it must be included in the sutures because it carries the blood vessels, and hæmostasis must also be obtained by our suture; if we agree that such a stitch cannot avoid penetrating the deeper layers of the mucosa

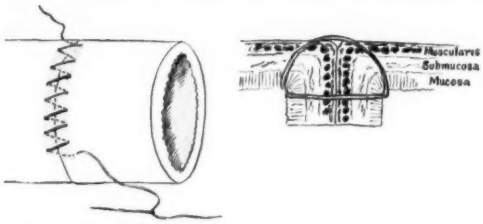

Fig. 8. The Lembert suture showing the area of potential infection of the peritoneal surface (shaded) after the stitch is pulled taut. In cross section, the course of the stitch through the walls.

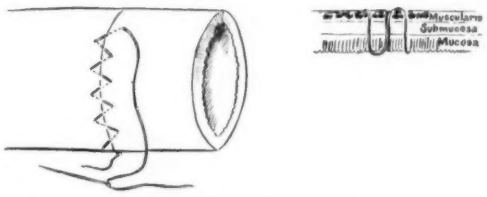

Fig. 9. The "baseball" suture, which approximates and secures hæmostasis, turning the edges neither in nor out. In cross section, the course of the stitch through the walls.

and therefore becoming infected; may we not arrive at some definite conclusions regarding suture materials, types of stitch, or even the choice of end-to-end or lateral anastomosis?

In the first place, since the stitches must and do enter the mucosa we cannot agree to the latest fashion in this field of surgery and talk of an "aseptic method of anastomosis." These are become quite the fashion (5). It seems to me, however, clearly improper to speak of asepsis if only one stitch penetrates the lumen and becomes infected. Nor does it help much, in my opinion, to assert that an aseptic operation upon the bowel is theoretically impossible yet practically attainable, as does Gatch (6): "Aseptic intestinal anastomosis by any suture method is theoretically impossible, but the amount of contamination can be so reduced that cultures taken at the line of sutures are sterile." That is, I would point out that cultures taken at the line of suture in culture media which may or may not be at all suited to the growth of the organisms, showed no growth; but also showed very little as to whether or not organisms which might well thrive in the peritoneal juices were or were not present. Nor can I agree with Roeder's concept (23): "perfect asepsis and practical asepsis must be appreciated and differentiated."

From the standpoint of the teacher of surgery there is no permissible qualification of the term asepsis. It is a term like "death"; one is either dead or he is not dead. There is a certain practical danger, too; for the less experienced may be inclined to chance an anastomosis by some such method in a case which might far better be treated by a three stage operation (21).

The idea behind these proposals, insofar as it relates to the obtaining of a cleaner field, is above criticism; for there are in surgery, as in housecleaning, various degrees of cleanliness. There is one point concerning these suggestions which is not mentioned except by Halsted, and that is the fact that the length of the inturned cuff, even though the cuff consist only of submucosa, bears a relation to the process of healing. It lies beyond the province of this discussion to take up this point, but I would recommend to the youthful enthusiast who proposes a new invention along this line, to go back and read the work upon the healing of intestinal sutures by Mall and Sabin (14).

If now we admit that every intestinal stitch upon which the surgeon may rely is a penetrating stitch, is infected, and at best opens the lumen of the intestine so that infection may travel along it, either by capillarity, or if not by capillarity, by direct growth along the line of the thread (3, 6), what are we going to do about it?

I believe that this problem is to be answered by employing a stitch which will lie completely buried in the wall, so that if and when infection follows along it, the infection will not advance to the peritoneal cavity. This can be done by using the Cushing stitch in preference to the overhand Lembert stitch (Figs. 7 and 8).

And what should be the material? I believe that fine catgut should be used for this stitch; we assume it to be infected, and we have known for many years that an absorbable suture works better in the presence of infection than does a non-absorbable suture. In our teaching we have always used fine silk, simply in order to demonstrate that in the course of time this stitch sloughs out into the intestinal lumen, and that if it be of silk, it may take a very long time before it is cast off. The suture used for approximating the edges and securing hæmostasis may, however, be of silk because it is in great part exposed to the lumen of the intestine and is drawn tightly to secure hæmostasis, and will therefore be thrown off much more easily than will the Cushing stitch, lying buried within the tissues.

The problem of whether a continuous or an interrupted stitch should be chosen seems also

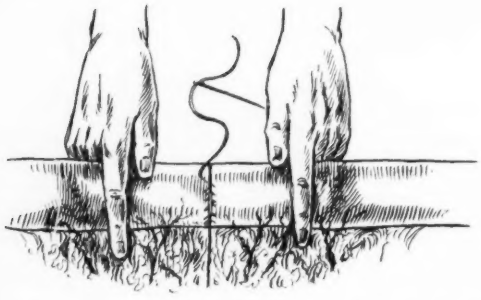

Fig. 10. The method of utilizing the fingers of an assistant to control the intestine.

answered by this consideration of not exposing the peritoneum to the spread of infection along the thread. With the exception of the Connell stitch interrupted stitches must be tied on the outside; the knot usually precludes this complete burying of the stitch. I have also never been able to attain as complete approximation with an interrupted stitch, and, further, since one of the objects is to obtain hæmostasis, it seems to me that a more reliable result in this respect is to be attained with a continuous suture.

The method for end-to-end anastomosis which years of teaching have led me to adopt is as follows. I do not claim it to be the best method, but I have found it a method which beginners can use, one which gives them an idea of the basic principles as I have set them forth.

Since the edges of the intestine must be approximated and hæmostasis must be secured, I use two rows of sutures, the first one being frankly for approximation and for hæmostasis. Since I can see no object to be attained by turning in very much of the gut wall, and many objections to such a procedure, I unite the cut edges by a mattress stitch which turns in the edges of the V of the mesenteric attachment, in order to make sure of this weak point, and then continue this same thread as a stitch which I have called the "baseball stitch," because it is laid in the same fashion as is the stitch which holds the cover of a baseball, passing in and out between the edges, turning them neither out nor in (Fig. 9). It is the stitch advocated by v. Schmieden (25) for closing the anterior edge of the lateral anastomosis, under the name of the old fashioned postmortem suture. Since, however, American surgeons, perhaps unfortunately, are more familiar with the baseball diamond than with the postmortem room, the term I have chosen seems to me to convey a more definite impression to their minds. It is a stitch

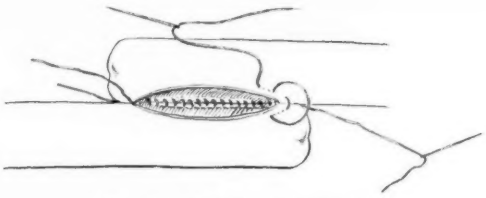

Fig. 11. The lateral anastomosis.

which I would use in no other place in surgery; I would not use it in the lateral anastomosis. This suture line is then inverted and buried by a continuous right angle Cushing stitch, in which, in turn, the Cushing suture itself is buried as completely as possible.

A practical point in the use of the Cushing stitch is that the needle should be inserted into the opposite wall not at a point exactly opposite its exit from the tissue, but at a point toward the middle of the "bite" last taken. This insures a more even drawing together of the tissues, and a more complete burying of the stitch (Fig. 7).

In doing this operation I do not use clamps, but control the intestine by using the fingers of an assistant as clamps (Fig. 10). Perhaps the main object in doing this is to keep the assistant happily employed, and to prevent him from constantly rubbing infection into the peritoneum with gauze sponges. After the anastomosis is completed the wound area can be gently cleansed, blood clots which will have formed by that time, if they have been given an opportunity to form, can be gently picked off, and the incessant damage wrought upon the delicate peritoneum by a zealous assistant has been avoided.

The lateral anastomosis is accomplished by following the same principles; first, a continuous Cushing stitch brings the two portions of intestine into juxtaposition. The opening is made, the cut edges lying side by side (posterior edge) are approximated and hæmostasis is attained by a running, overhand stitch. This is continued around the anterior edge as the Mayo stitch, which serves to turn in the edges which are rolling out, and which secures hæmostasis. The end of the first, the continuous Cushing stitch, is continued over this stitch of the anterior cut edges (Fig. 11).

It seems to me that the problem of the choice of an end-to-end or a lateral anastomosis rests entirely upon the principles thus far discussed, and is to be solved solely by a consideration of them. In the first place, it is to be noted that experimental workers seem to prefer the end-to-end, the majority of clinical workers, the lateral.

Fig. 12. The natural angle of approximation of two pieces of gut when they are laid side by side, contrasted with the artificial angulation which must be produced and held by the end-to-end suture.

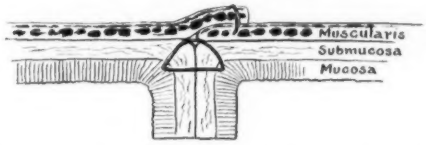

Fig. 13. A method which gives ideal results experimentally, but is not a practical suggestion.

I believe this is due to the difference in the nature of the tubes with which the two groups are working. The intestine of the dog is a relatively stiff, thick-walled tube, which gives a clumsy result as a lateral anastomosis; the human intestine is actually thinner walled, larger, more pliable, and the result of a lateral anastomosis is, therefore, far more workmanlike. Then, too, perhaps, without being able to explain why, the clinical surgeon prefers the lateral anastomosis, because in its performance the walls lie in such relationship that they naturally fall into approximation of their serous coverings, rather than having to be forced into an unnatural position by the suture, as occurs in the necessary angulation at the line of inturn of the end-to-end operation.

There seems to be a good deal of discussion of the physiological workings of an anastomosis. Probably all that Cannon and Murphy concluded (2) concerning the lateral anastomosis was correct, that there is, in the early period during which their studies were made, a certain disturbance of the passage of food along the area of the anastomosis. But the fact that both animals and human beings recover perfectly after the operation shows that Nature can adapt herself to whatever disturbance may result from the lateral anastomosis. There is a highly commendable growing desire among surgeons to consider the normal physiology, to devise operations which shall conform to the normal conditions; yet it does not appeal to me that it is necessarily poor surgery to take advantage of Nature's power of adaptation if thereby a desirable surgical end can be attained. It is not poor surgery to transplant a nerve of less important function to one of all-important function; it is not poor surgery to cause a loss of all sensation to the face if by so doing a tic doleureux may be relieved. Therefore, I believe that a lateral anastomosis on a thin walled gut, taking advantage of the natural approximation of the peritoneal covering and the consequent good concealment of the stitches, is far more "logical" than an end-to-end, regardless of the physiology; for we know that adaptation will occur even to the point that the gut becomes in time, even after a lateral anastomosis, a straight tube again (Fig. 12).

That food can collect in the blind ends has really nothing to do with the operation, for the leaving of such a blind end is not a part of a lateral anastomosis, any more than the leaving of an unsutured hole in an end-to-end is a part of the operation.

A very important problem remains to be considered, the question of adhesion formation. It has never been settled why adhesions form so readily to the line of suture. In the years of teaching I have had the opportunity to see several hundred intestinal anastomoses with the autopsy of the results both successful and unsuccessful; and I have seen but few end-to-end or lateral anastomoses which did not show an adhesion at some point or other to at least the omentum. In many cases these adhesions were but slight, and might have eventually become attenuated and separated. From these as the best results, the adhesions have varied all the way up to the result in which many coils of intestine were fastened together, producing sharp angulations and kinks, sometimes causing death. What produces these adhesions? Are they an essential part of the process of healing?

The first step in the process of intestinal repair is the throwing out of some sort of thrombin from the wound, which causes a coagulum of lymph and blood to form between the apposed surfaces of peritoneum. This fibrinous deposit may appear even before the operation is complete; it should be left in place unless excessive. It may be that the adhesions occur with this fibrinous deposit before the mesothelial cells have had an opportunity to grow over it. In such a case, adhesions might be looked upon as a logical sequence of operation, and we would have to direct them, rather than seek to avoid them.

Until such time as the process may be understood, I believe that the best practical surgery will direct this adhesive process in a direction which would do the least harm. All the experiments directed toward the complete prevention of adhesions by the use of oils, foreign membranes,

etc., have been failures; I know of none here or elsewhere which have met with any measure of success.

The least harmful adhesions are those with the free edge of the omentum; adhesions with neighboring loops of intestine are the most harmful; adhesions to the omental base might be very troublesome, causing a pull on the stomach. Therefore, I have advised that the operation be completed by placing the free omental edge around the site of the anastomosis, holding it in place by a single delicate stitch through the mesentery. I have never seen trouble result from such directed adhesions; I have seen trouble enough from those left to chance. But even in these latter, the most remarkable thing is Nature's ability sometimes to continue an apparently undisturbed function in spite of such abnormal conditions.

The main objection, in my experience, to the lateral anastomosis is that it offers such an extensive operative field for the formation of adhesions. The entire exposed length of the suture line, and both invaginated bowel ends, form surfaces for attachment of any other abdominal organ conveniently near.

Were it not for the peculiar tendency of the omentum to creep into the dimple formed by the invaginating of the end of the bowel by a purse-string suture, I should conclude from my experience that adhesions are the measure of the transfer of infection from the bowel lumen to the peritoneal surface. Perhaps the omentum has two separate ways of becoming adherent, a tendency to force its way into unnatural crevices, as into a hernial sac, and a tendency to cover infection which is progressing toward the surface.

My reason for suspecting infection as the cause of adhesions is based upon the fact that I have done end-to-end anastomoses which were followed by no adhesions at all; and in which there must have been a raw uncovered surface even greater than is found where serosa is brought into apposition with serosa.

These were performed in the following fashion: the serosa and the two muscle coats were dissected off to the submucosa. On the one end the separation was continued a little way under the muscularis so that a little flap was formed. This cannot be very long, else it will become gangrenous. The two ends were then brought together by a stitch as shown by the diagram (Fig. 13), the stitches being laid deep in the angle between submucosa and muscular coat, so that when drawn into position the little flap came to lie over the line of suture, and was held in place by a very delicate suture which involved only the muscle coats. This differs little from Shoemaker's suggestion, except that his sutures pass through all the coats and emerge on the surface of the peritoneum. I have endeavored to cover a stitch which I know to be infected, and which I know will act as a seton, by capillarity or direct growth or any way you will, with a little flap, which is held in place by a delicate approximating stitch which I know will not be infected. The raw edge of muscle must become covered with the same fibrinous deposit as characterizes the healing of the ordinary suture line; yet I have in a fair percentage of cases succeeded in obtaining a result marked by no adhesions at all. But the method is not a practical method.

Therefore, I say that from my own experience I believe that the adhesions represent the effort of the mesothelial cells of whatever organ is adjacent to control the spread of infection. Since I believe that the operation cannot be aseptic because the stitches must penetrate to infection if they are not to give way and precipitate disaster, and since to my mind the adhesions represent Nature's way of controlling the spread of this infection, I believe we are justified in utilizing this provision of Nature in such a manner as to do the least harm,—to use the free edge of the omentum, and to know where these adhesions will form.

How shall the refinement of the art of surgery be accomplished, this development of a more perfect technique which I have mentioned as being in my opinion one line along which we may expect the future of surgery to improve? There are two ways by which more finished products may result from mechanical processes. The first is by the methods of mass production, by which, by means of the development of men skilled in the management of highly specialized machines, the separate parts entering into the finished product are produced in a quantity and with a perfection impossible of attainment by one single worker. The other is by the development of more skilled craftsmen in case the product must represent the skill and labor of a single individual. Surgery is one-man work; the nearest approach to factory methods in intestinal anastomosis was represented by the Murphy button.

But surgery must ever remain among the old handicrafts, where methods become stabilized in basic principles because of the physical limitations of the materials with which the craftsman deals, and because one workman must finish the entire work. Therefore, refinement of technique, as in all other handicrafts since the beginning of time,

can only be an individual attainment; to the apprenticeship under a skilled workman must be added the years of practice until the art is acquired. And when the art is acquired one hears less discussion of method; the one sews with his right hand, the other with his left. No good craftsman sticks to the same method under varying conditions, for the material varies,—be it stomach, or small gut, or large intestine,—and all will vary according to the disease process for which the surgeon is operating. Therefore, the good craftsman aims at the finished result, whether by one method or by another; if the angles of his lateral anastomosis do not suit him when united by a continuous stitch he will add perhaps an interrupted stitch, tied on the inside; but he will have forgotten the method in his interest in the result.

The choice of method by the master workman will be the final product of knowledge of his materials, multiplied by experience, this raised to the *n*th power by the great guiding spirit of human activity, common sense,—the final product being the thing called "surgical judgment."

Even if this discussion should have served no end in helping to solve the problem of the technique of intra-abdominal surgery, it would be worth the while if it but served to impress upon surgeons, young and old, that the peritoneum is a single layer of delicate cells, thin, tenuous, transparent, beyond the scope of the human eye, all essential to surgical success; a thing somewhat like the electric current: we cannot see it or touch it, yet we can direct it,—with care!

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A METHOD FOR GASTRO-ENTEROSTOMY WITH A TRANSVERSE JEJUNAL INCISION

An Experimental Study[1]

By THEODORE S. MOISE, M.D., F.A.C.S., CUSHMAN D. HAAGENSEN, M.D., and EDWARD C. VOGT, M.D., New Haven, Connecticut

INTRODUCTION

ALTHOUGH the success of any type of gastro-intestinal anastomosis is largely dependent on its mechanical efficiency, too little attention has been given to certain faults inherent in the mechanics of the usual side-to-side gastrojejunostomy. These deficiencies are in part at least due to the division of the circular muscle fibers throughout the length of the stoma.

Cannon and Blake (1) made an extensive experimental study of the routine side-to-side method. They repeatedly noted that food was forced through the patent pylorus to enter the stomach again via the proximal loop of the gastrojejunostomy. This circulation of food was seen especially when the stomach was stretched, either by large amounts of water or by the application of pressure to the abdomen after moderate amounts of food had been given. They explained this phenomenon by the "valve-like" action of the anastomosis. When the wall of the stomach is stretched, separating the edges of the opening into the jejunum, the intestine becomes drawn tightly between them. Thus the intestinal wall forms a flat covering to the stoma and the openings into the intestine become merely narrow slits (Fig. 1A). The slit on the proximal side of the stoma permits food which circulates via the pylorus and duodenum to return into the stomach, but both slits offer a "valve-like" hindrance to the egress of food from the stomach via the stoma. The more the gastric wall is stretched the more effective these valves become. The phenomenon was also demonstrated in the excised stomach by filling it with water.

Cannon and Blake did not believe that their failures were due to this "valve-like" phenomenon. They ascribed the cases of obstruction in their series of experiments to the formation of kinks which were invariably located just distal to the point of attachment of the intestine to the stomach. They pointed out that sharp turns in the intestine under normal conditions are readily straightened out by the push of intestinal peristalsis.

However, at the stoma of the side-to-side gastrojejunostomy the circular muscle fibers of the gut have been cut. This interruption of the circular fibers makes it impossible for peristalsis to be effective at the angulation (Fig. 2) in the jejunum at the distal end of the anastomosis and hence, the force which normally would push the mass of food along and straighten the kink is lacking.

Various modifications have been suggested to avoid these defects in the side-to-side gastrojejunostomy. Kelling (2) thought that kinking was produced by making the stoma too large, so that when the stomach was stretched and the stoma further enlarged, a spur of intestine might project into the gastric cavity. Case (3) suggested that kinking might be entirely prevented by attaching a few centimeters of jejunum beyond the distal end of the stoma to the stomach wall.

Moise and Harvey (4) presented a method for anastomosis of the stomach and jejunum after a partial gastrectomy wherein the jejunum is incised transversely rather than longitudinally and the end of the stomach is anastomosed to the end of the jejunum, rather than the end of the stomach to the side of the jejunum as in the frequently used Pólya operation. The theoretical advantages of such a procedure over the usual end-to-side or side-to-side anastomosis are several: The procedure is an end-to-end anastomosis and should have the mechanical and physiological advantages that are generally conceded for this type of operation. In contrast with the Pólya type of gastrojejunostomy one avoids cutting the circular fibers over a wide area and accordingly there is no interference to peristalsis and no opportunity is afforded for the formation of an atonic dilated pouch opposite the stoma. The size of the stoma is approximately that of the cross section of the jejunum which is obviously the maximum possible size of the effective lumen in any type of anastomosis even though a long longitudinal incision into the intestine gives a seemingly larger opening. After this end-to-end gastrojejunostomy, the two loops of jejunum naturally gravitate downward, which is the optimum position for the maintenance of a patent stoma, while this same tendency for the loops to drop down after the Pólya anastomosis may tend to kink and partly occlude the lumen.

[1] From the Department of Surgery, Yale University, School of Medicine, New Haven, Connecticut.

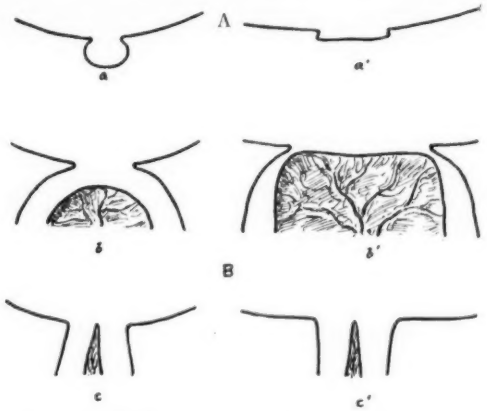

Fig. 1. A diagram showing the effect of extreme gastric dilatation on the stoma, *A*, in the usual side-to-side gastro-enterostomy (longitudinal jejunal incision); *B*, in the new type of procedure (transverse jejunal incision). The normal stoma is represented in the usual procedure in *a* and *b*, in cross section and longitudinal section respectively, and *c* represents a longitudinal section through the stoma after a gastro-enterostomy with a transverse jejunal incision. The dilated stomach is represented in *a'*, *b'*, and *c'*; the mechanism of valve formation is illustrated in *a'* and *b'*, while in *c'* the dilatation produces an enlargement of the stoma.

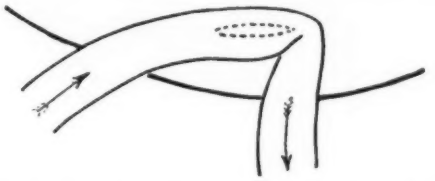

Fig. 2. A diagram illustrating the angulation distal to the stoma with the longitudinal jejunal incision (Cannon and Blake). With a transverse jejunal incision the gravitation of the intestinal loops produces no angulation but on the contrary maintains the patency of the stoma.

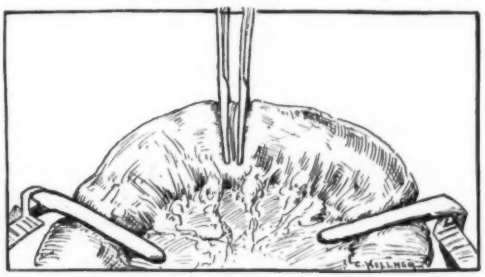

Fig. 3. The crushing clamps have been applied to the jejunum and an incision has been made across two-thirds of the diameter of the intestine.

The purpose of this communication is to report an experimental study of the application of the transverse jejunal incision to the usual gastro-jejunostomy.

EXPERIMENTAL METHOD

The end-to-side type of gastrojejunostomy with transverse jejunal incision was performed on a series of 10 dogs.

A comparable series of the usual side-to-side gastrojejunostomies were performed on 10 dogs. Except for the jejunal incision the operative technique and placing of the stoma were identical in the two series. In the side-to-side operation the stoma was made slightly larger than two fingers.

A constant site for the anastomosis was selected on the anterior[1] surface of the mid-antral region of the stomach, about 2 centimeters from and parallel to the greater curvature. In one-half of the animals in each series a pyloric exclusion was performed by transverse division of the stomach just proximal to the pylorus with inversion of the cut ends. The conditions of after-care were the same in all animals.

About one month after operation the animals were fasted over night and after a fluoroscopic examination, to determine whether the stomach was empty, they were given a semi-liquid feeding of 250 grams of a suspension of barium in potato starch and milk. A second fluoroscopic examination was made immediately and at intervals until the stomach was empty. The dogs were finally anæsthetized with ether and the abdomen opened for examination of the anastomosis *in situ*.

[1] For anatomical reasons an anterior gastro-enterostomy is preferable in dogs.

OPERATIVE TECHNIQUE FOR GASTROJEJUNOSTOMY WITH TRANSVERSE JEJUNAL INCISION

The procedure is identical with that previously described (4): The jejunum is lifted into position without rotation and with the proximal jejunal loop sufficiently long to avoid kinking. Two small crushing clamps are applied to the jejunum at the site selected for the anastomosis (Fig. 3). These clamps are placed side by side, extending transversely across two-thirds of the diameter of the intestine. An incision is made between the clamps and their handles are allowed to separate (Fig. 4). This portion of the jejunum is then united to the cut end of the stomach by a row of interrupted silk sutures forming the posterior row. Small intestinal clamps are placed on the proximal and distal loops of the intestine. The crushing clamps are removed and the crushed

Fig. 4. The crushing clamps have been separated and the jejunum has been attached to the stomach by a posterior row of interrupted silk sutures.

edges of the jejunum are excised. An incision is made into the stomach of the same length as the jejunal opening and the anastomosis is completed in accordance with the operator's preference. In these experiments a continuous through and through catgut suture of No. 0 chromic was inserted in the middle of the anastomosis posteriorly and was carried in either direction. This suture was continued around the angles as a continuous inverting mattress stitch. The anterior layer was reinforced with interrupted Lembert sutures to complete the anastomosis.

On completion of the anastomosis the jejunal loops gravitate downward at right angles to the stomach without kinking and in the optimum mechanical position (Fig. 5). The separate openings in each loop admit the index finger and thus afford a stoma approximately the size of the cross section of the jejunum and slightly larger than the normal pylorus.

DISCUSSION

The functional results in the series of 10 end-to-side anastomoses were uniformly good. The animals lost some weight, but not more than normal animals kept in cages. The roentgenographic studies showed that the stomach usually began to empty immediately after feeding. The emptying was never precipitous. The average emptying time for the series was 5¼ hours, which is approximately the same as that of a normal dog under similar conditions. In animals without pyloric exclusion the emptying was via both the pylorus and the stoma.

Finally, examined *in situ* the anastomoses looked much as they did upon completion of the operation. The stomach was never dilated. The loops of jejunum hung directly downward in the most favorable mechanical position (Fig. 5).

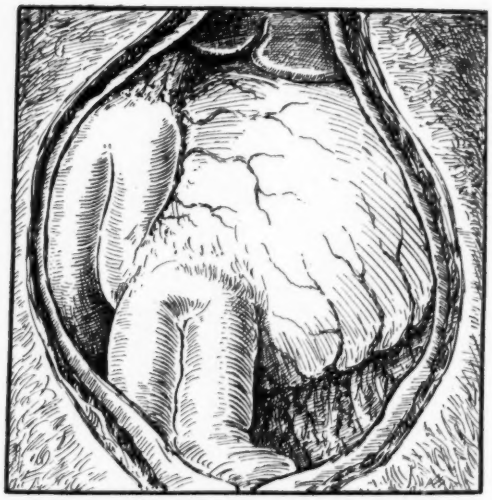

Fig. 5. The drawing illustrates a gastro-enterostomy with transverse jejunal incision as it appeared *in situ* after complete healing. The jejunal loops hang directly downward tending to maintain the patency of the lumen.

There was no evidence of "valve-like" action or kinking. Upon removal the specimens showed a patent lumen about the size of a cross-section of the normal jejunum.

In contrast, there were three poor results in the series of side-to-side anastomoses. In the 7 successful experiments the results were good with an average emptying time of 5 hours and 10 minutes (Fig. 6). The unsuccessful instances (3 in 10) showed definite evidence of retention both by roentgenographic study and at autopsy. In 2 animals the obstruction progressively became more and more marked and was accompanied by vomiting and emaciation. At approximately a month and a half after operation, fluoroscopic examinations showed that the stomachs were greatly dilated and full of fluid. They did not empty perceptibly within 6 hours and after 3 days showed definite retention. When the dogs were killed the stomachs were found to be greatly distended (Fig. 7). The stoma, in each case, was much enlarged and the opposite intestinal wall, where the circular muscle fibers had been cut was markedly stretched and ballooned out in line with the stomach wall, illustrating the "valve" formation described by Cannon and Blake.

The loops of jejunum gravitated downward from the angles of the dilated stoma producing a moderate angulation of the gut at the distal end of the anastomosis. The angulation was not as

Fig. 6. The drawing illustrates the usual gastro-enterostomy with longitudinal jejunal incision as it appeared *in situ* after complete healing. Although there was no evidence of stasis in this animal, a comparison with Figure 5 shows a flattening of the jejunal wall in the area of division of circular muscle fibers. One can readily see how the natural tendency for the loops to gravitate downward is an advantage with the transverse jejunal incision (Fig. 5) but would tend to produce an angulation and possibly an obstruction with the usual longitudinal jejunal incision (Fig. 6).

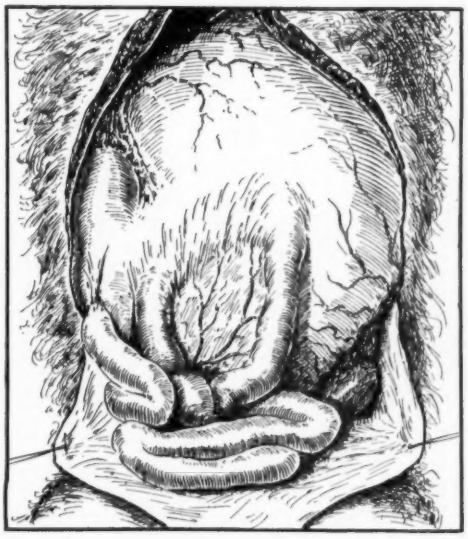

Fig. 7. The drawing illustrates an instance of a dilated stomach after the usual gastro-enterostomy (longitudinal jejunal incision) with the valve formation described by Cannon and Blake. There is moderate angulation of the jejunal loop at the distal end of the stoma. The stasis is due to this valve formation and angulation, which has been observed in several instances (3 in 10) with the usual gastro-enterostomy with longitudinal jejunal incision but in no instance with a transverse jejunal incision.

marked as the kinking which Cannon and Blake described, but was nevertheless an added mechanical disadvantage and probably contributed to the retention. There were no adhesions producing a constriction or causing an angulation of the gut. In the third dog the retention was less marked. By radiographic examination the stomach was moderately dilated and emptied slowly—20 per cent of the barium and considerable fluid remaining after 5 hours. At autopsy the stomach was found to be distended to half again its normal size. The stoma was stretched and the intestinal wall over it flattened but to a lesser degree than in the other 2 cases of obstruction. The angulation of the jejunum at the distal end of the anastomosis was also apparent in this case. Of the 3 dogs showing evidence of obstruction, 2 had had a pyloric occlusion and the third had not.

It is, of course, only possible to surmise the sequence of events in these cases of retention. It is probable that the dogs took too much food and water, producing distention with the concomitant "valve" formation by the stretched stoma associated with angulation of the gut at the distal end of the anastomosis. This condition, once established, will tend to become gradually worse by the accumulation of the normal secretions or by the further ingestion of food and water and finally results in the end picture of chronic obstruction described above.

SUMMARY

The faulty mechanics of the usual side-to-side gastrojejunostomy are in large part due to the division of the circular muscle fibers by the longitudinal jejunal incision.

A method of anastomosis (4) has been previously described whereby the jejunum is incised transversely rather than longitudinally in order to avoid division of the circular muscle fibers. The theoretical advantages in this procedure are several: The circular muscle fibers are not severed and accordingly there is a minimal interference with peristalsis, the intestinal loops gravitate downward without kinking, in the ideal mechanical position, and finally, distention of the stomach

has no tendency to produce obstruction but on the contrary maintains the patency of the lumen.

In the experiments, herewith reported, a comparison is made between the usual gastrojejunostomy with longitudinal jejunal incision and a new method with a transverse jejunal incision. This study reveals a practical demonstration of the above described theoretical advantages of the transverse incision. In a series of 10 dogs this procedure has proved to be mechanically and functionally satisfactory.

In contrast, a comparable series of 10 gastrojejunostomies with the usual longitudinal jejunal incision resulted in 3 cases of obstruction due to the formation of "valves" already mentioned. A preliminary report of the clinical application of this procedure will be made at an early date.

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THE UTILIZATION OF THE ROUND LIGAMENTS IN TUBAL STERILIZATION

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DURING the past few years the question as to the best method of effecting tubal sterilization has been vigorously discussed, following a change in the whole aspect of the problem resulting from reports of failures incident to the favorite method—double ligation of the tubes with division between them. In this connection, the familiar fact may be adduced that in some of those cases the lumen of the tube has become restored after absorption of the ligatures or a tubo-abdominal fistula has become established followed by pregnancy. Much information as to the mechanism involved in such occurrences has been derived from the experiments of Fraenkel and Nuernberger.

The difficulty of rendering a woman either permanently or temporarily sterile by an operation upon the tubes, is reflected in the numerous attempts which have been made to accomplish this object. The method suggested for conferring temporary sterilization on patients by burying the fimbriated end of the tube in the broad ligament, has proved not infallible (Hofmeier, Reifferscheid, Ruehl, Muret). For insuring against conception in such cases during a temporary contra-indication to pregnancy, it has been suggested, therefore, by Menge to place the fimbriated end of the tube outside of the abdominal cavity by means of a modified Alexander-Adams operation. This procedure, when properly performed, is undoubtedly efficient. It constitutes, however, an operation *per se*, and whenever the abdominal cavity is being opened for cæsarean section or hysterotomy, an abdominal method for tubal sterilization is more desirable.

To achieve the purpose of sterilization, there are at present two operations in vogue: burying the proximal ends of the tubes between the folds of the broad ligament, or excising the tubes at the cornua of the uterus by wedge-shaped incisions. The latter procedure is certain in its results; but, if pregnancy seems desirable at some future time, a second operation to reimplant the tubes into the uterine cornua would offer but problematical results. Failures after inserting the proximal ends of the tubes in the broad ligament have been reported by Reifferscheid, Leonard, and Nuernberger. Moreover, I think it safe to say that the data available in the literature apparently do not fully represent the actual number of failures, since their occurrence is frankly admitted by several surgeons in casual conversation. As a matter of fact, Williams observed no untoward results in his series of operations. While I am not prepared to discuss the factors which might probably operate in causing these failures, such facts cannot be swept aside with indifference, if we are to obtain a clear basis for judgment. Furthermore, a number of obstetricians hesitate to open the upper part of the broad ligament when they are confronted with excessive engorgement of the veins in that area for fear of hæmorrhage or thrombosis. Moreover, the following fact has to be borne in mind: "It is sometimes difficult to bury the ends of the tubes satisfactorily on account of the very delicate structure of the upper part of the broad ligaments, and if an attempt is made to spread them apart, the tissues may be so torn that it becomes necessary to excise the cornual end of the tube by a wedge-shaped incision" (Williams). The facts here stated seem to bear out the view that the methods available today have not entirely solved the problem, so that desirability of obtaining a simple but effectual method of tubal sterilization still exists.

The considerations brought forth induced me to utilize the round ligaments in tubal sterilization for obstetrical and gynecological indications; in obstetrics, following cæsarean section or hysterotomy; in gynecology, associated with interposition for procidentia. The operation described here is readily effected and can be performed in either of two ways.

Method 1. After the fallopian tube has been cut, its proximal end is ligated with silk, the suture being left with long ends. One end of this suture is then inserted through the round ligament on one side, while the other end passes through the ovarian ligament. Consequently, when the ends of the suture are pulled together, the round and ovarian ligaments will be approximated over the cut end of the tube so that they eventually envelop it in a blind cul-de-sac, when tied closely (suture *1* in diagram). Because of the possibility that the end of the tube might project slightly below the fold produced by suture 1, a second suture is inserted about 1 centimeter below it, but

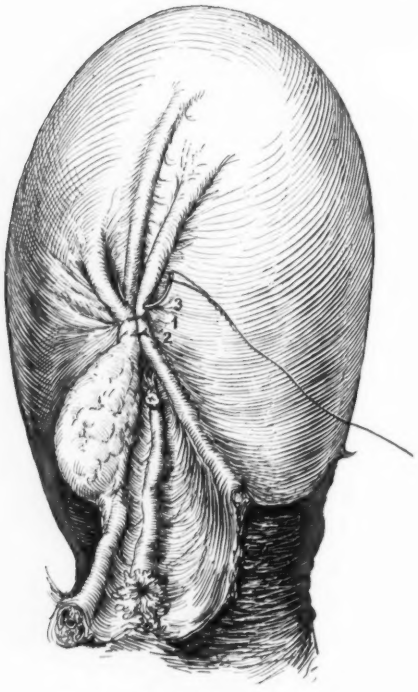

Fig. 1. Diagram showing method 1.

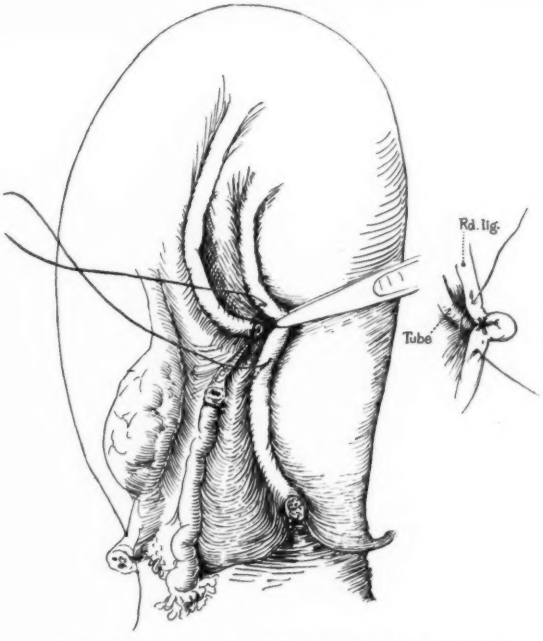

Fig. 2. Method 2. When the ends of the suture are drawn together the stump of the tube will be buried in an artificial niche produced by the posterior surface of the round ligament.

including only the round and ovarian ligaments, and thereby effectually obviates the possibility of the entrance of an ovulum through the free end of the tube (suture *2*). As a further precaution against a possible pulling out of the first suture, an additional suture is inserted about 1 centimeter higher up, so that the round ligament and the tube are united again (suture *3*).

One or more superficial sutures introduced between sutures *1* and *2* conclude the procedure.

Method 2. The principle involved in this method is practically the same as that employed in the fixation of the inverted stump of the appendix to the cæcum. The tube is severed in its mid portion, or at the junction between the middle and outer thirds. The proximal cut end of the tube is then ligated with silk or silkworm-gut. Then, with a fine French needle, a suture is inserted through the round ligament, which is pulled up in a loop by means of a dissecting forceps, then through the tube, and again through the round ligament. By consulting the diagram it will be seen that when the ends of this suture are drawn together, the stump of the tube will be buried in the artificial niche which has been produced in the posterior surface of the round ligament. As a matter of precaution, the area where the end of the tube will rest is scarified, and an additional suture is introduced in the same way through the round ligament and tube as described above. In order to make it sure that the blind end of the tube is entirely covered, a few superficial sutures are then inserted through the round ligament, which roll its edges in (see insert of diagram). Whenever possible, as an additional precaution, the ovary is laid over the seroserous suture line and fixed in this position by one stitch.

All deep sutures should be made with silk, in order to prevent too rapid absorption of the suture material. For the seroserous sutures, however, chromic catgut is preferable. A minor point in the technique may be mentioned here: Since a small artery which supplies the requisite nourishment runs within the round ligament, the sutures introduced through the ligament should involve only its upper half.

I have, in a limited number of cases, employed the methods described as the procedure of choice

since 1917, with uniformly good results. It is evident that this operation is applicable to every case, since it is not contra-indicated by complications existing within the broad ligament. For operations by the vaginal route, method 2 is preferable, since the approximation of the round and the ovarian ligament might be rather difficult in some cases. The essential difference between the routine method of burying the tube between the folds of the round ligament and the method described above, lies in the fact that in the latter case the cut proximal end of the tube is covered with the comparatively thick muscular layer of the round ligament, thus obviating the action of any factor which might result in perforation of the peritoneum (mechanical, traction; or chemical, ferment). In such circumstances, when a merely temporary sterilization is intended, a second operation would unite the liberated ends of the tube whenever pregnancy in some future time seems desirable. In one of my cases, pregnancy occurred after the tubes had been made free and a fresh cut surface of the tubes was established.

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THE BALKAN FRAME AND ITS USE IN GENERAL SURGERY[1]

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THIN, poorly-nourished patients, weakened by malignant disease of long standing, often present serious problems of postoperative treatment. Decubitus ulcer, hypostatic pneumonia, delayed healing of wounds, and wasting of muscle tissue are all encountered following a prolonged, or at times even a short, stay in bed by the patient with malignant disease, and appropriate preventative and curative measures for such complications and sequelæ should be at the hand of every surgeon for the comfort of the patient postoperatively.

The adoption of the Balkan frame marked a great advance in the care and comfort of certain orthopedic patients. Recently a Balkan frame, equipped with an overhead swinging crossbar (Fig. 1), has been used for 4 patients, 2 males and 2 females, who had undergone posterior resection (the Kraske operation) for carcinoma of the rectum. The aid afforded the nurses in attendance by this device, the decreasing amounts of morphine necessary, and the uniformly enthusiastic praise from the patients encouraged this report.

The device is especially suitable for patients who must submit to the two-stage Kraske operation. Preliminary colostomy is performed through a left rectus or left inguinal incision, splitting the muscle. The patient remains in bed for approximately 10 days before being allowed up. During this period a debilitated patient tends to continue to lose muscle tonus; the musculature is soft and flabby, and the constitutional weakness and loss of strength initiated by the malignant condition progresses further. Care of the skin is of prime importance as pressure dermatitis even to the point of ulcer formation is not uncommon. Dehydration, loss of the subcutaneous fatty layers, and the pressure sustained on bony prominences, as over the sacrum, the anterior iliac spines, and the trochanters of the femurs, readily account for these stages.

The second stage or posterior excision of the rectum is usually undertaken at the end of the twelfth to the fourteenth day, if the patient's general condition permits, and sacral anæsthesia and light gas-oxygen anæsthesia are used in case the peritoneum is opened or incised, and traction is applied. The structures of the pelvic floor, principally the levator ani, rectococcygeal and coccygeal muscles with the pelvic fascia, are severed and rendered functionless. On being transferred to bed the patient is placed on his side. With a colostomy wound anteriorly and an extensive wound with bulky dressing pads in place poste-

[1]Submitted for publication July 29, 1926.

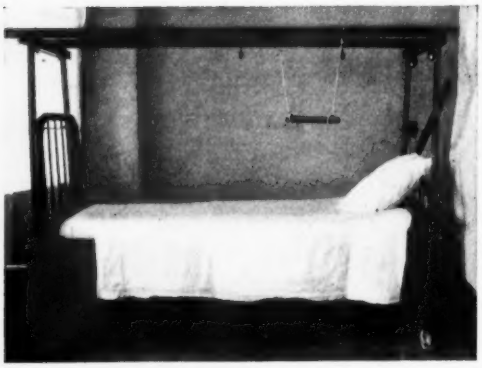

Fig. 1. Balkan frame with crossbar in place.

Fig. 2. Patient in act of turning body.

riorly, it follows that weight-bearing is possible only on the right or left side, the trochanters of the femur sustaining the principal burden.

The patient requires a nurse in attendance chiefly because of his inability to change his position in bed. At this period of the convalescence a constant, intractable aching soreness develops in the hips and legs and finally in the entire body, associated with sleepless nights and a general lowering of morale. Irritability, spells of depression and crying, and a state of high nervous tension often occur at this time.

A Balkan frame equipped with an overhead swinging crossbar attached to the bed enables the patient to raise and turn the trunk and body (Fig. 2), easily assume new positions and rest tired muscles at will. With increased comfort and activity a decidedly beneficial physical effect on the tonus and strength of the musculature of the upper extremity, back, abdomen, and legs is noted. Improvement in the mental attitude of such a patient is striking, the insomnia is improved, the appetite returns and a decided general improvement occurs.

For the first patient a Bradford frame was used in conjunction with the Balkan frame. This was subsequently discarded since it prevented the free range of motion possible on a flat surface.

AVULSION OF THE HEEL[1]

By RALPH COLP, M.D., F.A.C.S., New York City

AVULSION of the heel, either complete or incomplete, while not a common accident is certainly not a surgical rarity in industrial hospitals. If not treated properly it may become a serious condition because certain anatomical features of this region make it the easy prey of chronic ulceration. Ulcers of the heel when once formed are disabling and annoying to the patient, and usually resistant to most forms of medical therapy. The problem which these cases present depends upon the period at which the patient applies for treatment, and is best illustrated by reviewing 2 cases each exemplary of a group. In Case 1, the patient was treated from the time of his initial injury; in Case 2, the patient applied for relief from a chronic ulcer of the heel which he had had for over a year.

The mechanism producing this injury is either a heavy glancing blow applied directly to the heel, or the posterior part of the foot is crushed between two approximating forces which may be of sufficient strength not only to cause avulsion of the heel but a fracture of the os calcis in addition.

The treatment depends upon the pathological changes present. Whenever possible, the wounded heel should be thoroughly cleansed and débridement carefully done, after which the heel should be replaced by accurate suturing. In a great many of these cases, healing will take place by primary union. The torn tissue in a certain number of cases subsequently will become gangrenous and slough away, and a defect of greater or lesser extent be left. If the area is quite small and superficial, healing may occur by secondary intention and the resulting scar, if adequately protected, may never cause the patient any trouble. On the other hand it is a grave error to temporize when the heel is completely torn away or secondary gangrene has resulted from exposure of the Achilles tendon and part of the os calcis. These large defects are only temporarily healed by scar tissue formation, for as soon as the patient walks about in shoes, the skin invariably breaks down. It is an economic waste of time to treat large chronic ulcers of the heel conservatively. They can be cured only by radical surgical intervention. The defect or scar tissue present must be replaced by a transplant including skin and subcutaneous tissue liberally supplied with fat. Any operation not embodying all of these specifications will usually result in failure. Thiersch, Reverdin, or Wolf grafts will not answer the purpose; the only satisfactory procedure is the use of a pedicle graft with a liberal supply of subcutaneous fat. The general rules which apply to pedicled grafts for other areas of the body apply here.

The comfort of the patient should be borne in mind when an area for the pedicled graft is selected, even though any position if maintained for a prolonged period will become unbearable and no matter what precautions are taken, these patients will be miserable. Opiates should be used liberally to alleviate their suffering. The area selected should have a good blood supply and the tissues should be liberally supplied with fat. All these requirements seemed fulfilled best by using the anterior aspect of the upper third of the thigh. When the heel is elevated to this location, the position obtained is comparatively and relatively comfortable for the patient, the pedicle is well nourished and without tension, and the graft secured quite desirable for the purpose.

It is very important at the operation to cover the muscular base left bare by the elevation of the pedicle with Thiersch grafts. This accomplishes many things. It prevents materially the constant secretion which would otherwise come from a raw area. This not only diminishes the chances of infection, but adds to the comfort of the patient because dressings, which are painful, need to be done less frequently. In addition, it shortens the period of convalescence and diminishes the chances of scar tissue formation and contraction which in the upper third of the thigh might seriously restrict the free movements of the quadriceps femoris. These Thiersch grafts should be covered with paraffine mesh, liberally supplied with sterile gauze and the entire dressing should be encased by sterile rubber dam. This forms an impermeable membrane between the thigh wound and the uncovered granulating heel which, because of necessity, must rest on the rubber dam.

Before the pedicle is cut, the heel, which has now been covered with clean healthy granulations and freed of all scar tissue, is scrubbed with soap and water for at least 5 minutes and then washed with alcohol and ether. Débridement of the thin line of fresh epithelium from the periphery of the wound is carefully done. Any troublesome oozing may be controlled by the ap-

[1] From the Surgical Clinic of the Beekman Street Hospital.

Fig. 1. Case 1.

Fig. 2. Case 2.

plication of a hot towel with good firm pressure. It is extremely important that the pedicle have a fertile vascular base because the periphery of the ulcer alone will be insufficient to insure proper nourishment of the graft after the pedicle has been severed.

In Case 2, the heel was made up of scar tissue and the posterior surface of the os calcis covered by sickly pale granulations. In order to cover the os calcis with granulations of a healthy and clean type, multiple holes were drilled into the body of that bone so that granulations might arise from the medulla and eventually cover the cortex. This plan succeeded extremely well and within a few weeks the entire area to be grafted was covered with healthy granulations.

With the heel prepared and the graft cut the foot is elevated to the anterior aspect of the thigh and the heel brought to rest upon the rubber dam. The graft is then sutured to the periphery of the ulcer and in order that the raw surface of the graft may rest securely against the granulations of the heel, two sutures, parallel with the long axis of the graft, are passed through it and the granulations of the heel. When these are tied the pedicled graft accurately fits the contour of the heel. In order that any secretion which might collect may have a free portal of escape, a few stab wounds of small caliber are made through the graft to the underlying heel.

In Case 2 the graft before it was sutured into place was perforated with at least one dozen holes made with a Dakin punch.

Absolute immobilization is a *sine qua non* for successful pedicled grafting. This can only be accomplished by encasing the lower half of the body in a plaster spica, and because of the peculiar position of the lower extremities this plaster spica must be firmly reinforced by basswood splints. It has been found quite helpful to place the patient upon the Hawley fracture table at the beginning of the operation and after anæsthesia has been induced the extremity from which the pedicle is to be taken is fixed to foot piece with bandages while the other extremity remains free. After the operation has been completed, the lower half of the table is dropped and the usual spica can then be easily applied. No dressing is placed directly over the wound excepting a sterile towel. This may be removed when the graft has to be inspected, without discomfort. At the end of 10 days the pedicle may be divided, first partially and within 24 hours completely, and the free end of the graft sutured with the periphery of the wound or permitted to heal under adhesive strapping. The cast is then removed.

It is extremely important to warn the patient to protect the heel with thin pads of rubber sponge when wearing a shoe. This pad inserted between the heel and the shoe will protect the insensitive grafted area from a friction burn which may easily occur without the knowledge of the patient.

The 2 cases with photographs illustrate the procedure outlined in this paper.

Case 1. C. G., age 35 years, male, a porter, was admitted to the surgical service of the Beekman Street Hospital November 8, 1925, and discharged January 6, 1926.

While attempting to stop an elevator he missed the rope and his right heel was caught and crushed between the floor of the moving elevator and the floor of the building. An ambulance brought him to the hospital immediately after the injury.

The past and family history was not relevant. Physical examination was negative except for a surgical condition which disclosed an obliquely lacerated wound about 4 inches in length resulting in a partial avulsion of the right heel down to the Achilles tendon. Roentgen examination showed an incomplete fracture of the os calcis of the right heel without displacement.

Course. The patient was removed to the operating room immediately upon admission and the wound thoroughly irrigated with saline solution for about 15 minutes, then cleansed with alcohol and ether. A thorough débridement was then performed. The laceration was sutured with silkworm gut and silk, and the wound dressed with vaseline gauze.

November 12. The wound had apparently healed without infection but the lower flap of skin covering an area of about 2 by 3 inches had become black and gangrenous.

November 19. The necrosis of skin over the heel had extended so that an area of about 3 by 5 inches was involved. The underlying granulations in areas, however, were fairly clean and the os calcis was visible.

December 8. The wound had cleaned up very satisfactorily. Granulations were healthy and exuberant, and the condition seemed satisfactory for a pedicle graft.

December 10. *Operation:* Pedicle graft from anterior aspect of left thigh to right heel.

The patient was placed and fixed upon a Hawley table. The area of the right heel was thoroughly cleansed and scrubbed vigorously with green soap and water followed by alcohol and ether. Since this procedure caused bleeding the weeping area was covered with a hot towel and pressure applied by the hand of an assistant. A full thickness

pedicle graft was cut in the region of the anterior aspect of the upper third of the left thigh measuring about 3 inches in width and about 5 inches in length. The base of the graft ran parallel to Poupart's ligament. The thickness of the graft included all tissues between the skin and the deep fascia of the thigh. The muscular surface which had been left bare by raising the pedicle was carefully covered with Tiersch skin grafts which had been removed from the anterior aspect of the right thigh. These grafts were covered with paraffine gauze and gauze dressings, over which a rubber dam was applied. The right heel was then brought up to the anterior aspect of the left thigh and the periphery of the graft was sutured to the periphery of the wound of the heel for about 200 degrees of its extent with interrupted silkworm gut sutures. Two sutures were passed parallel to the long axis of the graft through it and the heel so that the graft was firmly attached to the underlying granulations covering the posterior aspect of the os calcis. In order to permit secretions to escape through the graft it was perforated in several places with a Dakin punch. The parts involved were then rendered immobile by a plaster spica which completely encased the lower half of the body. The area of the graft itself was simply covered with paraffine gauze overlaid with a sterile towel so that inspections could be made without removing cumbersome dressings.

December 12. The graft was completely viable. Under novocain anæsthesia the pedicle which was firmly attached was incised for a distance of about 1 inch on each side at its base. There was free bleeding from the distal segment.

December 23. Under novocain anæsthesia, the pedicle was entirely divided and the free portion of the flap was sutured to the remaining free skin edge of the heel with interrupted silkworm gut. The plaster cast was removed and the area covered by the Tiersch grafts was dressed for the first time. It was found that all the grafts had taken. The patient was discharged January 5, 1926, with the heel completely healed. He was last seen June 23, 1926, and was able to walk about perfectly. The heel was still completely healed.

CASE 2. H. C., age 17 years, male, occupation, handyman, was admitted to the surgical service of the Beekman Street Hospital, March 26, 1926, and discharged July 3, 1926. Fourteen months before admission the right heel had been crushed between the street and the platform of a moving elevator. The patient was removed to a hospital where he received conservative treatment, rest in bed, and the local application of wet dressings. In spite of the fact that the wound, which involved practically the entire heel, contracted down to about the size of a fifty-cent piece, a chronic ulcer remained, and it was necessary for the patient to be dressed about three times a week. Because of this condition he was unable to secure employment.

Physical examination was negative except for the surgical condition. The entire heel was a mass of scar tissue except for a granulating area about the size of a fifty-cent piece on the posterior medial aspect of the right heel. The granulations were pale and sickly in appearance. The os calcis seemingly lay beneath the scar tissue and the granulating area. There was a deformity of the foot from a contracture of the flexor of the leg resulting in apparent talipes equinus.

Roentgen examination of the foot showed an old complete fracture of the os calcis about midway through its body. This had now healed with the posterior fragment turned markedly to the inner side; and, that it was a comminuted fracture was indicated by a hole through the outer side of the bone. There was a rather large deforming callus present.

Course. April 3. Part of the scar tissue about the heel was excised and about a dozen holes were drilled into the os calcis with the hope that granulations might spring up from the medulla covering the cortex with healthy granulations. The leg was placed in a plaster cast with the foot in complete dorsiflexion.

April 13. The wound was clean and granulations were flourishing and were beginning to cover in the wound. There was still much scar tissue surrounding the area of granulations and this would have to be removed before any attempt at pedicle grafting was made.

April 28. All scar tissue was removed and another dozen holes drilled into the os calcis.

May 7. An area about 5 by 3 inches was covered in parts with healthy granulations.

May 10. The wound was thoroughly cleansed with green soap and water, and 10 more holes were drilled into the os calcis.

An X-ray picture of the heel at this time did not disclose any infective osteomyelitis.

May 16. The entire heel was covered with granulations of healthy appearance. The cast was removed.

May 17. Operation. A pedicle graft from the anterior aspect of the left thigh was attached to the right heel for a large ulcer involving the posterior portion of the heel extending from its inferior margin upward on the Achilles tendon for the extent of 5 inches. The transverse diameter of this was about 3 inches. The technique of this operation was identical with that employed in Case 1.

May 23. The pedicled graft was completely divided. The area which had been covered with Thiersch grafts was dressed and it was found that all of the grafts apparently had taken.

June 1. The pedicled graft which had been left free was now sutured in place with interrupted silkworm gut sutures. Following this there was some sloughing in the superior part of the grafts which on June 17 was covered with 5 small pinch grafts. July 3, the patient was discharged.

The patient was seen August 10, 1926. The heel had completely healed with excellent functional results.

THE USE OF MERCUROCHROME 220 SOLUBLE IN PERITONEAL AND OTHER CAVITIES FOR SEPSIS

By RICHARD T. DAVIS, M.D., Fredericksburg, Virginia

THE success of mercurochrome 220 soluble in the field for which it was originally intended has led to its experimental use in many others, with the result that reports are continually being made of new uses for the drug. The following is a report of a series of 21 grave surgical cases from my hospital in a period of 2 years, in which I made free use of mercurochrome in 0.5 per cent and 1 per cent solutions, introducing from ½ to 4 ounces in the peritoneal and pleural cavities, with excellent results. The drug thus administered does not occasion the characteristic sharp rise in temperature which follows its intravenous use, possibly because its absorption is gradual, and no evidence of kidney irritation was found. There were 12 cases of appendicitis with free pus and a generalized peritonitis; 2 cases of empyema or lung abscess; 1 case of ruptured urethra and bladder; 2 cases of ectopic gestation; 1 case of salpingitis; and 3 cases of intestinal obstruction. Of the 21 patients, 19 fully recovered and 2 died. In detail they are as follows:

Case 1. B. S., white, female, age 17, entered the hospital November 8, 1923, with a temperature of 100 degrees F., pulse 130, respirations 26, white blood count 12,000, polymorphonuclears 92 per cent. She was found to have a ruptured appendix with free pus in the abdomen, and a generalized peritonitis. The appendix was removed in the usual way, drainage introduced and one ounce of 0.5 per cent solution of mercurochrome 220 soluble poured into the peritoneal cavity. The patient's temperature rose to 102 degrees in 24 hours, after which it did not go over 100 and became normal on the fifth day; she was discharged in 4 weeks.

Case 2. M. S., white female, age 20, came with a temperature of 98 degrees F., pulse 124, respirations 30. She was found to have a ruptured appendix, free pus in the abdomen, and a generalized peritonitis. The appendix was removed in the usual way, free drainage established and 2 ounces of a 1 per cent solution of mercurochrome 220 soluble was poured into the peritoneal cavity. The temperature remained low, not rising above 99. The patient made an uneventful recovery, being discharged on the twenty-first day.

Case 3. J. S., white, female, age 22, temperature 98 degrees, pulse 120, respirations 28, entered the hospital with an ectopic gestation. After blood clots were removed, the pelvis was swabbed out with a 1 per cent solution of mercurochrome 220 soluble. The temperature remained low. The patient was discharged on the twenty-third day.

Case 4. E. B., white, female, age 42, temperature 98 degrees, pulse 100, respirations 24, white blood count 12,000, polymorphonuclears 86 per cent, entered the hospital with a ruptured tube and free pus in the abdomen. The appendix and tubes were removed, the pus evacuated, drainage introduced and 1½ ounces of 0.5 per cent mercurochrome 220 soluble instilled into the peritoneal cavity. Temperature did not rise above 100. The patient recovered and was discharged on the thirty-fifth day.

Case 5. G. A., white, female, age 30, temperature 99 degrees, pulse 82, respirations 22, white blood count 5,800, entered the hospital with a bowel obstruction due to angulation of the ileum, a portion of the gut gangrenous, and a generalized peritonitis. Six inches of gut were resected, 1½ ounces of 0.5 per cent mercurochrome 220 soluble was introduced into the peritoneal cavity with drainage. There was a rise of 1 degree in the temperature in 24 hours. After 2 days the same amount of mercurochrome was again introduced into the cavity, with no rise in temperature. The patient made a good recovery and was discharged on the thirtieth day.

Case 6. M. H., white, male, age 30, temperature 97 degrees, pulse 108, respirations 24, entered the hospital with a lung abscess. It was drained and a large amount of pus evacuated. Dakin's solution was first used with negative results, then 1 per cent mercurochrome 220 soluble in 1 ounce instillations at 3 day intervals. No rise in temperature was noted. The patient recovered and was discharged on the twenty-eighth day.

Case 7. E. S., white, male, age 21, temperature 97 degrees, pulse 90, respirations 20, white blood count 18,000, polymorphonuclears 85 per cent, was found to have a hernial sac containing strangulated gut full of dark fluid, the gut being in very poor condition. After being freed, the gut was wrapped in hot towels for 30 minutes, then thoroughly painted over with 1 per cent solution of mercurochrome 220 soluble, and returned into the abdominal cavity. One-half ounce of 0.5 per cent mercurochrome was poured into the wound. There was a rise of temperature of 1 degree in 24 hours. The patient recovered and was discharged after 28 days.

Case 8. S. F., white, female, age 6, entered the hospital with a ruptured appendix and free pus in the abdominal cavity (probably of tuberculous origin). The appendix was removed and ½ ounce 0.5 per cent mercurochrome 220 soluble introduced into the cavity. The patient died on the seventh day after developing meningeal symptoms, probably of tuberculous origin.

Case 9. J. W. C., male, colored, age 10, temperature 99 degrees, pulse 120, respirations 22, was found to have acute appendicitis, with a large amount of pus in the abdomen, and a generalized peritonitis. The appendix was removed and 1 ounce 0.5 per cent mercurochrome 220 soluble introduced into the abdomen with drainage. The temperature rose 1 degree in 12 hours. A like amount of mercurochrome was again introduced into the cavity in 48 hours, with no rise in temperature. The patient recovered and was discharged on the fifty-third day.

Case 10. A. B., male, colored, age 12, temperature 98 degrees, pulse 110, respirations 24, white blood count 11,000, polymorphonuclears 82 per cent, entered the hospital with a ruptured appendix, free pus in the abdomen, and a generalized peritonitis. The appendix was removed and 1 ounce 0.5 per cent mercurochrome 220 soluble was introduced with drainage. No rise of temperature followed. Introduction of 1 ounce mercurochrome was repeated in 36 hours. The patient recovered and was discharged on the thirty-third day.

CASE 11. J. E., male, colored, age 19, temperature 98 degrees, pulse 130, respirations 22, entered the hospital with an obstruction of the bowels caused by a narrow band of adhesions over lower ileum. The intestines above the obstruction were in poor condition and some fluid was found in the abdomen. One ounce of 0.5 per cent mercurochrome 220 soluble was introduced with a cigarette drain. The temperature remained normal. The patient recovered and was discharged on the fourteenth day.

CASE 12. L. L. L., white, female, age 36, temperature 100 degrees, entered the hospital on January 28, 1925, with an ectopic pregnancy and an enormous hæmorrhage. The mass was removed, 1 ounce 0.5 per cent mercurochrome 220 soluble introduced and the wound closed with drainage. Temperature went to 103 on third day. The patient recovered and was discharged on the sixteenth day.

CASE 13. N. B., white, male, age 35, temperature 98 degrees, pulse 90, respirations 22, white blood count 12,000, polymorphonuclears 68 per cent, was found to have a ruptured gangrenous appendix and a large pus cavity walled off. The appendix was removed, the pus evacuated, and 1 ounce of 1 per cent mercurochrome 220 soluble introduced with drainage. Obstruction symptoms supervened on the fourth day with temperature normal. One ounce 0.5 per cent mercurochrome 220 soluble was introduced into the cavity, and the lower portion of the ileum drained through the abdominal wall. The patient recovered and was discharged on the seventy-seventh day.

CASE 14. R. J., white, male, age 27, temperature 99 degrees, pulse 128, respirations 28, entered the hospital with left empyema. The chest wall was incised between the sixth and seventh ribs, 2 liters of pus evacuated and drainage introduced. On the sixth day 1 ounce of 1 per cent mercurochrome 220 soluble was injected into the cavity and the same amount again on the eighth and twelfth days. The patient left the hospital greatly improved on the twenty-first day with a small amount of drainage still continuing and eventually made a complete recovery.

CASE 15. E. B., colored, female, aged 13, temperature 102 degrees, pulse 104, respirations 24, white blood count 17,000, polymorphonuclears 94 per cent, entered the hospital with a retrocæcal appendiceal abscess. The appendix was removed, the abscess cleaned out, thoroughly swabbed with 1 per cent mercurochrome 220 soluble, and the wound closed with 2 drains. The temperature came down and hovered around 99. The patient recovered and was discharged on the twenty-eighth day.

CASE 16. D. N., white, female, age 15, temperature 100.2 degrees, pulse 120, respirations 26, entered the hospital with a ruptured gangrenous appendix, a large amount of free pus in the abdomen and a generalized peritonitis. The patient's general condition was bad. The appendix was removed, pus drained off and 4 ounces 1 per cent mercurochrome 220 soluble introduced into the cavity, with 1 flank and 2 anterior drains. The temperature rose 3 degrees in 6 hours and came down to 101 after 9 hours. The patient recovered and was discharged on the twenty-first day.

CASE 17. R. B., white, male, age 40, temperature 98 degrees, pulse 100, respirations 24, entered the hospital with a urethra ruptured at neck of bladder. A suprapubic cystotomy was performed and a drainage tube introduced through the bladder and on through the urethra, 2 quarts of bloody urine being found in the bladder. The bladder was irrigated with boric acid solution, followed by 3 ounces of 1 per cent mercurochrome 220 soluble. There was no rise of temperature. Instillations of mercurochrome were repeated every third day, and boric acid solution twice daily. The patient was discharged on the forty-ninth day, after complete recovery.

CASE 18. G. S., white, male, age 56, temperature 99 degrees, pulse 96, respirations 24, white blood count 10,000, polymorphonuclears 94 per cent, entered the hospital with a gangrenous, ruptured appendix, a large amount of free pus in the abdomen and a generalized peritonitis. The appendix was removed and 2 ounces of 0.5 per cent mercurochrome 220 soluble was introduced with flank and central drainage. The same amount of mercurochrome was introduced again on the third day. On the fourth day, the white blood count was 6,000, polymorphonuclears 74 per cent. The urine contained albumin and many coarsely granular casts. The patient had chronic nephritis and died on the ninth day.

CASE 19. C. C., colored, female, age 20, temperature 98 degrees, pulse 96, respirations 24, white blood count 10,000, polymorphonuclears 81 per cent, entered the hospital with an acute catarrhal appendix, a ruptured right tube and the abdomen full of free pus. The appendix and tubes were removed and 2 ounces 0.5 per cent mercurochrome 220 soluble introduced with drainage. Four hours after operation, the temperature rose to 101, pulse 138, and remained so 24 hours. The patient recovered and was discharged on the twenty-fifth day.

CASE 20. R. M., white, male, age 16, had a temperature of 99.8 degrees, pulse 94, respirations 22, white blood count 13,000, polymorphonuclears 93 per cent. A swollen appendix was removed, also a Meckel's diverticulum perforated by a toothpick which the patient had swallowed, and two ounces of 0.5 per cent mercurochrome 220 soluble were introduced with a small cigarette drain which was removed after the first day. There was no rise of temperature. The patient made an uneventful recovery and was discharged on the eighth day. (This case was reported in the *Journal of the American Medical Association*, May 29, 1926.)

CASE 21. J. M., white, male, age 13, temperature 99 degrees, pulse 100, respirations 24, white blood count 12,000, polymorphonuclears 89 per cent, entered the hospital with a ruptured appendix, a large amount of free pus in the abdomen, and a generalized peritonitis. The appendix was removed and 1¼ ounces of 1 per cent mercurochrome 220 soluble was introduced with drainage. The temperature rose 1 degree in 24 hours. The patient recovered and was discharged on the thirty-fifth day.

In view of the severity of the 21 cases and of the remarkably good results obtained in 19 out of the 21, I am led to the conclusion that the use of mercurochrome 220 soluble was the controlling factor. I consider that the direct application of mercurochrome to the source of the infection, whether in the peritoneal, thoracic, or other cavities, is indicated.

CORRESPONDENCE

TISSUE DIAGNOSIS IN THE OPERATING ROOM

AND IMMEDIATE COVER-SLIP EXAMINATIONS OF ALL FLUIDS AND PUS[1]

To the Editor: I will consider it a courtesy if you will publish this letter in your journal, as I am anxious to come into correspondence with pathologists and surgeons interested in the immediate examination of tissue by frozen section in the operating room and the immediate cover-slip studies of smears from all fluids and pus.

Microscopic examination of frozen stained sections has been possible for more than a quarter of a century. The staining of unfixed frozen sections with polychrome methylene blue and other stains is a well established procedure. In many operating rooms, in both large and small universities, and in surgical clinics, provision for these immediate diagnostic studies have not only been available, but have been in practical use for years. On the other hand, unfortunately, this diagnostic part of the operating room is conspicuous by its absence in many clinics.

Before 1915 it was rarely necessary for a surgeon well trained in gross pathology to need a frozen section to help him in diagnosis at the operating table. Since 1915, and especially since 1922, the public has become so enlightened that malignant disease formerly easily recognized either clinically or in the gross, now appears in our operating rooms devoid of its easily recognized clinical and gross appearance and can be properly discovered only by an immediate frozen section. The majority of operating rooms are not equipped or prepared for this new diagnostic test.

The first essential part for this diagnosis is the technician—one to cut and stain the frozen section, or to make and stain the smear. The second is a pathologist trained to interpret it. It is possible for the surgeon to be all three in himself, and some young surgeons are so equipped. In others it is a dual combination—surgeon and pathologist in one, and the technician. More frequently it is three—operator, technician, and pathologist. It makes little difference whether it is one, two, or three individuals, provided one has the equipment and training for this most difficult diagnostic test.

In the address as chairman of the surgical section of the Southern Medical Association, I discussed biopsy, and this paper has been published.[2] A reprint of this paper will be sent to anyone on request.

Schools for technicians may have to be established in different sections of the country, and the surgical pathological laboratories of the medical schools and the larger surgical clinics should offer courses in this tissue diagnosis, so that surgeons may learn to become their own pathologists or pathologists learn the particular needs of the surgeon in tissue diagnosis in the operating room.

It is quite true that when the majority of the public are fully enlightened, the surgeon will see lesions of the skin, oral cavity, and subcutaneous tumors when they are so small that their complete excision is not only indicated, but is possible without any mutilation. The chief danger here will be a surgical mistake—the incomplete removal of an apparently innocent tumor. There is no necessity here for biopsy. If a proper local excision is done, no matter what the microscope reveals, that local operation should be sufficient. But when lesions of the skin, oral cavity, and soft parts are extensive and their complete radical removal mutilating, then there must be biopsy to establish the exact pathology.

In the past, tumors of the breast and diseases of bone came to the surgeon at a stage when diagnosis could be made clinically, or from the gross appearances at exploration. But now, in an increasing number of cases, the breast tumor must be explored, and the gross pathology of this earlier stage is not sufficiently differentiated to allow a positive diagnosis. Immediate frozen sections are essential to indicate when the complete operation should be done. The same is true of the earlier stages of lesions of bone. The X-rays no longer make a positive differentiation between many of the benign and malignant diseases, for example, sclerosing osteomyelitis and sclerosing osteosarcoma.

We must not only specialize in tissue diagnosis, but we must organize this department so it will function properly in as many operating rooms as possible in this country.

Then there is a final and most difficult question to consider. I doubt if it can be settled. What shall be done in those operating rooms in which there is no technician to make the sections and no one trained to interpret the microscopic picture? How can a piece be excised or a tumor removed, for example from the breast, and this tissue sent to some laboratory for diagnosis without incurring the risk of delay to the patient? I have discussed this point in my paper on biopsy.

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[2] South. M. J., 1927, xx, 18.

[1] Submitted February 3, 1927.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.....Managing Editor
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JUNE, 1927

THE KOCHER ABDOMINAL FIXATION FOR CERTAIN TYPES OF PROLAPSE OF THE UTERUS

MORE than 25 years ago I first visited Theodor Kocher's clinic at Berne, Switzerland. I was very much interested at that time in an operation which Kocher was performing for prolapse of the uterus which was so simple and so generally applicable to aged women, that I have practiced it in certain groups of cases since with great satisfaction.

I visited Kocher's clinic again in 1913. At that time he was 72 years of age, but strong and vigorous, carrying on his work with his accustomed energy. He had remembered all those years my interest in his operation for prolapse of the uterus and with great kindness took the trouble to have present at his clinic for examination 17 women of different ages on whom he had operated for this condition. In each case some years had elapsed since the operation and every patient had been cured. A number of his patients were in the childbearing period, but in these he severed the attachment of the fallopian tubes and ovaries to the horn of the uterus and dropped the tubes and ovaries inside the abdomen. I have never used the operation for a patient in the childbearing period. In younger women plastic operations for the rectocele and cystocele, combined with shortening of the round ligaments by the external or internal method of Alexander, give satisfactory results. In those forms of prolapse of the uterus so frequently found in the menopause period, the C. H. Mayo type of operation of restoration of the pelvic floor is satisfactory.

There have been many modifications of the Kocher operation which have rendered it more difficult and, while I have had no experience with the changes in procedure, I do not believe they possess any substantial advantages over the original procedure.

The operation of Kocher is simple and can be performed in a few minutes, under a local anæsthetic with a little general anæsthetic during the intraperitoneal manipulation.

A suprapubic incision is made in the median line large enough to permit any necessary examination of the abdominal viscera. The uterus is then drawn up into the abdominal incision in such a manner that the uterus at the level of the internal os can be readily sutured to the parietal peritoneum all the way around; the body of the uterus is then sutured to the muscles and the aponeurosis. In the maneuver the bladder comes up with the uterus and the anterior space is closed by suturing the peritoneum to the cervix so that there will be no danger of subsequent internal hernia. The abdominal incision is closed in the usual manner. After the wound is healed, the fundus of the uterus can be readily felt

through the abdominal wall as a suprapubic tumor.

In my earlier experience I followed the Kocher operation, after a suitable interval, by perineal operations for the cystocele and rectocele, but I learned that these were not often essential. Drawing up the uterus after Kocher's method will draw up also, as a rule, both the rectocele and the cystocele, obviating the necessity for plastic operations on the vagina. One of the causes of prolapse is that when the uterus descends it carries the bladder with it, and when the prolapsed bladder is filled with urine it drops below the pubes, exerting a downward traction which increases the prolapse. By the Kocher operation the bladder is carried above the pubes, like a child's bladder, so that as it fills with urine it exerts an upward drag which undoubtedly is an important factor in bringing about permanent cure. On completion of the operation a self-retaining catheter may be introduced into the bladder and allowed to remain several days.

In elderly women with large prolapsus, when the extruded cervix is eroded and in poor condition, the preliminary use of vaginal packs of glycerine tampons for some days is often advisable for restoration of the uterus to its normal situation, to relieve the œdema and infection, and to secure again the right of pelvic habitation. Cervical erosions with prolapse of the uterus are common but they seldom eventuate in cancer.

In making this suggestion for the use of the Kocher operation, I have in mind first the ease and safety of performance and the excellent results which follow, and second a little remembrance of the work of one of the world's great surgeons.

Theodor Kocher was born August 25, 1841, in Berne, Switzerland. At the age of 31 he was appointed professor of surgery at the University of Berne, a position which he held until the time of his death, July 27, 1917.

W. J. Mayo.

DUODENAL FISTULA—THE EFFECT OF THE LOSS OF GASTRIC, DUODENAL, PANCREATIC, AND BILIARY SECRETIONS FROM THE BODY

In a previous editorial in this journal,[1] attention was called to the chemical changes in the blood occurring in cases of clinical and experimental duodenal fistulas. Such changes are characterized by a decreasing concentration of chlorides, elevation of urea, and a rise in the carbon dioxide combining-power of the blood. In patients and in experimental animals the control of the toxæmia and the restoration of the blood to normal have been accomplished by the intravenous injection of large amounts of physiological sodium chloride solution. The similarity of these changes in the blood to those described by certain observers as associated with upper intestinal stasis has led to further studies of the rôle of disturbed gastro-intestinal continuity, coincidental with duodenal fistula and the effect of the loss of gastric, duodenal, biliary, and pancreatic secretions from the body through the fistula.

By isolating the duodenum as a separate loop and restoring gastro-intestinal continuity by gastrojejunostomy, loss of gastric secretion is prevented, but duodenal, pancreatic, and biliary secretions are discharged from the body if the lower end of the duodenum is left open and incorporated in the abdominal wound. By transplanting the major pancreatic duct and the common bile duct into the jejunum, and ligating the minor pancreatic duct, the pan-

[1] The toxæmia of acute duodenal and gastric fistula. Surg., Gynec. and Obst., 1926, xlii, 849-850.

creatic and biliary secretions are retained in the gastro-intestinal tract while the duodenal secretion, without the constituents of the transplanted ducts, is discharged from the duodenum through the fistula.

When duodenal, pancreatic, and biliary secretion is lost from the body by discharge from the isolated loop of duodenum after the restoration of gastro-intestinal continuity by gastrojejunostomy, practically no change occurs in the chlorides or carbon dioxide combining-power of the blood. In such animals acid gastric secretion is not a part of the duodenal fluid because of the gastrojejunostomy and hence is not discharged from the body. This is in contrast to the condition when acute duodenal fistula is discharging gastric secretion in which a lowering of blood chlorides, an increase in the carbon dioxide combining-power of the blood and of the urea occurs. However, animals discharging pancreatic, biliary, and duodenal fluid from the isolated loop of duodenum die within 7 days, in spite of restoration of gastro-intestinal continuity, and regardless of whether sodium chloride is given intravenously. If the loss of pancreatic and biliary secretion is prevented by transplanting these ducts into the jejunum, the dogs live indefinitely. One such dog has lived more than 4 months and is in good condition.

Experiments were carried out by transplanting the common bile duct into the jejunal loop of the gastrojejunostomy in certain dogs, and in others by transplanting the pancreatic duct. Dogs in which the pancreatic secretion discharged from the loop of isolated duodenum invariably died early while those in which the loss of pancreatic fluid was prevented by transplanting the major pancreatic duct into the jejunal loop and ligating the minor pancreatic duct, did not die even though bile and pure duodenal secretion were being discharged from the open end of the isolated loop of duodenum. This seems to show that pancreatic fluid is necessary for life and is in accord with the work of Elman and McCaughan.[1]

These experiments further support our earlier contentions that the decrease in blood chlorides and carbon dioxide combining-power of the blood in duodenal fistula is due in part to loss of these constituents of gastric secretion from the body by discharge through the fistula. There is also experimental evidence[2] which seems to show that when there is interference with gastro-intestinal motility, the chlorides are lost from the body by their excretion into the intestinal tract and their discharge through a duodenal fistula or in the fæces and urine. The disturbance in gastro-intestinal continuity secondary to the fistula causes greater excretion of chlorides through the fistula and in the urine and fæcal fluid and a greater decrease in blood chlorides.

WALTMAN WALTERS.

[1] Elman, R., and McCaughan, J. M. On the collection of the entire external secretion of the pancreas under sterile conditions and the fatal effect of total loss of pancreatic juice. J. Exper. Med., 1927, xlv, 561–570.

[2] Walters, W., and Bollman, J. L. The toxemia of duodenal fistula. Physiologic changes concerned in the production of its characteristic blood chemistry changes. J. Am. M. Ass. (In press).

MASTER SURGEONS OF AMERICA

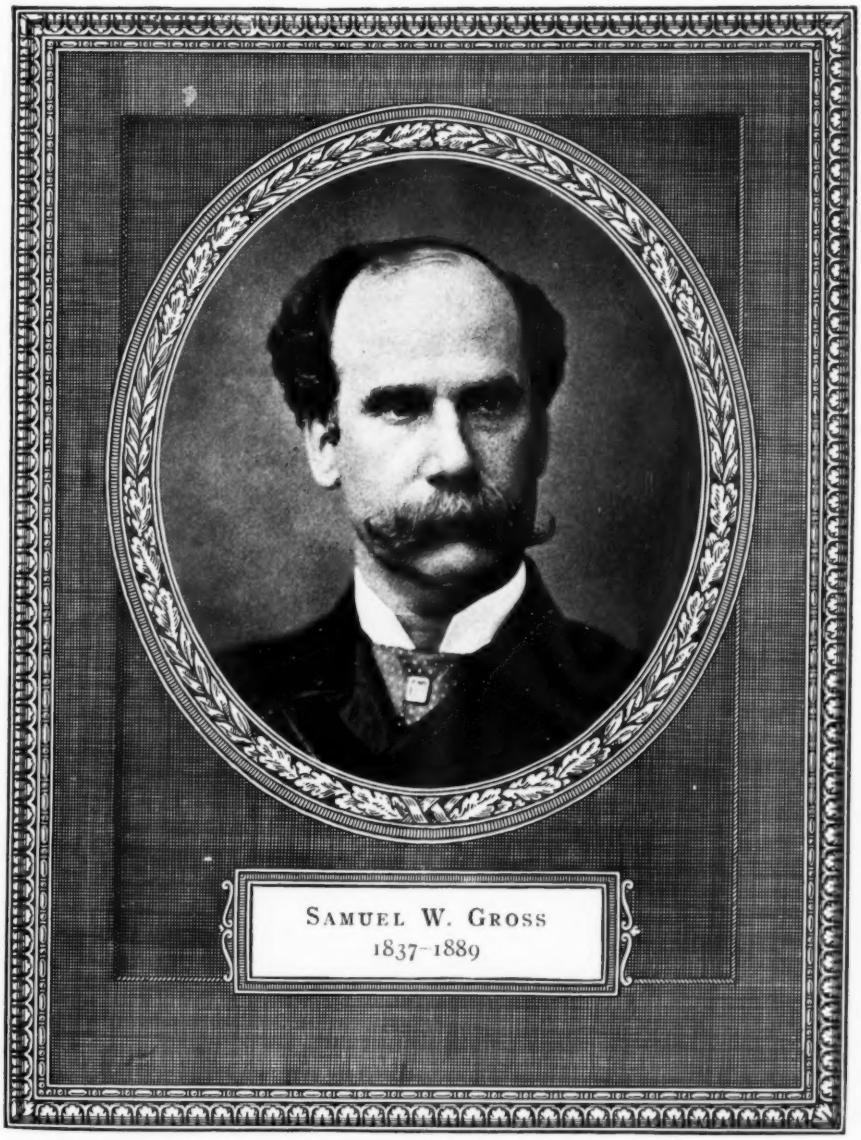
SAMUEL W. GROSS

IT is a common observation that distinguished men seldom have distinguished progeny and this unfortunately applies to medicine as well as to other walks in life. In literature occasionally the mantle of the father has fallen on the son and has been worn gracefully, but such cases are exceptional. In American medicine we have a few instances, particularly in Boston and Philadelphia, where ability, diligence, and ambition seem to have been inherited by or inculcated in a second or even a third generation, but as a rule the sons of a distinguished father are contented to live and die in a reflected glory.

Most men who have risen to great heights in their profession have done so, not only in spite of but because of handicaps and obstacles, the most common being poverty and a lack of preliminary education. Naturally one of the objects in the life of such men is to remove these hindrances from the path of their offspring, so that their ascent may be rendered less arduous. Human nature unfortunately seems to be so constituted that effort is born largely of necessity and material comforts stunt ambition and initiative. Wealth is consequently the poorest inheritance a father can pass on to a son, unless with it goes a love of knowledge and a sense of responsibility. Undoubtedly, something worked for and attained, be it wealth or knowledge or accomplishment, has a higher value and is more stimulating than the same thing easily procured.

It is a pleasure, therefore, to contemplate the life of a distinguished son of an equally or more distinguished father and that is the object of this brief review of the skill and accomplishments of Samuel W. Gross. The life of the "Elder Gross" has recently been set before the readers of this journal by the inimitable J. Chalmers Da Costa, and the present writer recently endeavored to present him from a little different angle.[1] It is hard to write of the son without constantly thinking and writing of the father, who was for so many years the most distinguished and most honored American surgeon. The father overcame his environment and grasped his opportunities, the son profited by his environment and appreciated his opportunities. A consideration of the two lives together can only produce the conclusion already mentioned that knowledge and accomplishment attained by constant struggle are apt to lead to greater heights than those come by easily.

[1] Ann. of Med. History, 1925, Dec.



SAMUEL W. GROSS
1837–1889

"The Younger Gross," as he was commonly called was born on February 4, 1837, graduated in medicine at Jefferson Medical College in 1857, was made professor of surgery in this institution on the resignation of his father in 1882 and died of pneumonia on April 16, 1889. Like his father he was a great teacher taking his responsibilities seriously and not using his position as a simple means of displaying his skill as an operator. He probably was a more brilliant operator than his father, but like him and all other great teachers of surgery he laid the greatest emphasis on pathology, diagnosis, and judgment.

His most striking and lasting contributions to surgical literature were those dealing with surgical pathology and his practical contributions were based largely on his pathological studies. Those which stand out most prominently and which are still quoted today are his articles on bone sarcoma and his monograph on "Tumors of the Breast," all of which may be considered masterpieces. Ewing in his "Neoplastic Diseases" says that "Gross's description of the origin, structure, clinical characteristics and treatment of bone sarcoma stands today as the classic contribution on this subject." In insisting upon the comparatively benign character of the giant cell sarcoma, he did not hesitate to oppose the generally accepted views of Billroth.

Our modern operation for carcinoma of the breast we owe largely to Gross as it was he who more than 40 years ago practiced and insisted on the wide excision of the skin and the invariable dissection of the axilla. His operation has been called the dinner plate operation, because the skin incision corresponded to the periphery of the breast. He always removed the sheath of the pectoralis major and sometimes a part of this muscle. He also advised resection of the axillary vein if small adherent glands could not be removed from it. This complete operation which he recommended and which is now looked upon as absolutely essential was opposed by many of his contemporaries on the Continent, in England, and in America. There can be no doubt that his masterly contributions to this subject caused the abandonment of the incomplete operation which was being done everywhere. His own late results compare favorably with those obtained today.

His work on tumors exhibits many resemblances to the writings of his illustrious father. It shows a careful study of the life history of disease, a thorough knowledge of pathology, of anatomy, both gross and histological, and on these are based the treatment he recommends.

Gross was greatly interested in the diseases of the genito-urinary tract and he wrote repeatedly and extensively on the subject of "Sterility in the Male." In this connection it is interesting to note that he died childless, although his widow, who later married William Osler gave birth to two children.

The "Younger Gross" was a great surgeon, a scientific and progressive surgeon. His death at the age of 52 was a great loss. His contributions, however, to surgical literature will long outlive the memory of the man. JOHN H. GIBBON.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha

THE CURE OF GUNSHOT WOUNDS BY LEONARDO BOTALLO

WOUNDS have always been more or less infected but owing to the forms of the causative agents in early times the great majority were not particularly severe. In warfare the poisoned arrow was in common use and the results were known, but no accurate differentiation had been made between the results due to the poison on the arrow head and the infection from bacteria. When with gunpowder wounds became more severe, infection followed and the inference was readily drawn that the infection was the result of poison transmitted to the missile by the powder or that the wounds were burned by the powder. These ideas were put forward by John de Vigo and Alphonso Ferri. No sooner was this theory advanced than opponents to it sprang up and a dispute arose which was to be carried on among surgeons for centuries until finally settled by the discovery in the nineteenth century of the causative bacteria. The name of nearly every surgeon of prominence is found in the literature of this dispute, even Paré and John Hunter playing their parts, and among others is found the name of Leonardo Botallo who published his work, "Concerning the Cure of Gunshot Wounds" in 1560.[1]

Botallo was born at Asti in Piedmont about 1530. He pursued his medical studies at Padua where he received his degree of doctor of medicine and surgery and probably here studied anatomy with the famous Gabriele Falloppio. About this time Botallo's name became inseparably connected with the ductus arteriosus, but how or why this connection came about is not established, though it was not by the discovery of the duct for its existence was known even in the time of Galen. Being interested in surgery particularly, he was called to war and first served as a surgeon in the French Army where he obtained considerable experience in the treatment of wounds. He went to Paris in 1564 and apparently gained the favor of the Royal Family, possibly because he was a fellow countryman of the then real ruler of France, Catherine de Medici, the widow of Henry the Second. Whatever the reason for his success with the Royal Family, he served as physician in ordinary to three sons of Catherine; King Charles the Ninth, Francis, Duke of Alençon, and King Henry the Third. Following this connection with probably the most famous, if not the most powerful court in Europe, Botallo seems to have turned away from surgery and become more interested in medical conditions and particularly in the practice of bleeding. The medical world at this time was divided into two camps: Pierre Brissot (1478–1522) had revived the Hippocratic method of bleeding as opposed to the ideas of Galen and the Arabians who taught that blood should be drawn slowly, drop by drop from the side opposite the inflammatory lesion while Hippocrates and his follower Brissot believed that venesection should be free and at the site of inflammation. As was natural, the swing of the pendulum carried many to excess and among these was Botallo who taught that blood should be taken frequently and in large quantities even to exsanguination. Though he did not publish his great book on bleeding until 1577 he nevertheless states his position as a believer in the Hippocratic doctrine of derivation in this work on gunshot wounds, thus aligning himself with the followers of Brissot.

Though he lets bleeding run away with him, he nevertheless holds his head in his treatment of wounds. He does not believe that gunshot wounds are poisoned or burned and in this he says he differs from John de Vigo and Alphonso Ferri. He then goes on to prove to his own satisfaction at least that he is right. His method is interesting. He takes up the ingredients of gunpowder one by one and by applying their humoral qualities to them shows that they can neither poison nor burn. To prove his points on burning he goes back to Aristotle, Averroes, and Galen. He quotes Dioscordes on the components of powder and shows that they are nonpoisonous either when applied locally, eaten, or smelled. He then quotes clinical cases and finally leads on to the conclusion that foreign bodies which cause laceration and decay of tissue are responsible. So he says the proper treatment of wounds consists in the removal of foreign bodies and restoration of parts to as nearly normal condition as is feasible. As foreign bodies he includes pieces of fractured bone, contused and lacerated tissue and blood clots. In fractures of the skull he follows Berengerius and as the illustrations show his instruments are quite similar.

Botallo deserves recognition as one of the early sound thinking men to whom surgery is indebted for a step at least in its progress toward independent ideas as contrasted with blind following of the ancient authorities.

[1] Courtesy of Library of University of Nebraska, College of Medicine, Omaha, Nebraska.

DE CVRANDIS VVLNERIBVS SCLOPETORVM,

AUTHORE LEONARDO Botallo Aſtenſe Medico.

LVGDVNI,
APVD GVLIELMVM ROVILLIVM,
SVB SCVTO VENETO,
M. D. LX.

Sed nec hippomocleati vectes, eleuatoria dicta, ſub ſilentio ſunt prætereũdi, quorum officio roſtris coruinis, vel gruinis, inuicem adiuuantibus, non rarò à labore, & periculo patientes liberauimus, vbi potiſsimum magna ſit oſsis labefactatio, quorum formas hic ſubiecimus.

Nunc quomodo horum ſingulũ in vſum veniat, expromere tempeſtiuum eſt. Duæ igitur terebrarum figuræ, quarta ſcilicet & tertia ſphærulam oſsis ſecant, amplitudini inſtrumentorũ & magnitudini reſpondentem, & vſui præcipuè veniunt in colliſionibus vel fracturis, in quibus os firmum eſt, quod auferre eſt neceſſum, vel in fracturis punctim illatis, vel cõcuſionibus paruis, vel quæ quandoque ex ſclopettorum glande fit,

Prætereà non perinde vt in ſimplicibus fracturis commendantur ligaturæ, ſic, & in hac conſerre cenſendum eſt. Nam in illis reunitio tantùm affectæ partis expectatur: hic autem primò extrantearũ rerum ablatio, mox deperditi regeneratio, quæ non niſi temporis diuturnitate fiunt. Quibus ſuccedere debet ſeparatarum partium vnitio, aut (ſi malis) copulatio. Pro qua re ſatius erit, abſque ligaturis illud immotum, & ſitum, atque naturalis illius figura expetit, ſeruare, tantúmque illud pannis tegere, ne aëri expoſitum malè habeat. Sed quia quandoque vulnus in membri parte eſt, quæ ſuper ſtrato reponitur, vt poſterior cruris, vel brachij pars, ſic vt nos cogat, quacunque hora curationis ipſum eleuare. Quò igitur minore motu, minoréque moleſtia id fiat, inſtrumentum iam dictum ex ærea lamina, in quo

membrum reponitur, ſcindatur, vel perforetur ea parte, qua vulnus reſidet, ſic vt cõmodè

Tertius modus eſt, quum ſine terebellis ſola ſerra & ſcalpris, præcipuè cum os amplum eſt, quod tundendum venit, auferimus, verum vt dictum eſt, adunco vel acuto ſcalpro, (ſi libeat) ſulci parãdi ſunt, ne huc atq; illuc ſerra fluat, vel pedetentim ſecura manu ſola ſerra parare viam poteris, ac quantum oporteat ſecare, ad hanc pura formam vel aliam, vt ipſa oſsis affectio monebit.

Serra brevis eſto, ſubtilis, dentibúsque bene acu

REVIEWS OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Mo.

WHEN the gynecologist Zweifel,[1] and Payr the general surgeon, conceived the idea of editing an extensive work on malignant tumors from the standpoint of the clinician, they rendered a conspicuous service to the medical profession. The last of the three volumes, which has just appeared, is devoted to gynecology. It is a stately tome of 656 pages and, like its predecessors, has been written by a number of men all of whom are outstanding authorities in their respective fields. Thus, the chapter on malignant growths of the ovaries is contributed by Doederlein, that on tumors of the uterus by Paul Zweifel. Kuestner discusses malignancy of the vagina, vulva, and clitoris, Zangemeister the relations of cancer of the bladder and urethra to the genital organs. Zweifel Jr. describes the malignant tumors of the tubes and round ligaments, and Frankl the pathology of chorionepithelioma. The principles of X-ray treatment are presented by Wintz, the treatment with radium by Frankl. A chapter on malignancy of the mammary gland in both sexes is by Kleinschmidt. Keysser deals with vaccine therapy of malignant new growths, and Joest, finally, adds a discussion on malignant neoplasms in animals.

The enumeration of the contents gives an idea of the scope of the work but does not convey the admirable manner in which the pathological anatomy is here linked up with the clinical aspect of malignant affections. It has often been deplored by thoughtful medical educators that the study and teaching of pathology, as, indeed, of all so-called fundamental branches, is shut off by itself, is too much out of touch with the application to the living human subject. *This book supplies the connection.* Pathology is made, as it should be, the handmaiden and the boon companion of the diagnostician, the surgeon, the radiologist. The work thereby becomes equally valuable to the specialist and the general practitioner.

It is true that our treatment of cancer is still very incomplete, but does this fact justify the profession in being discouraged? Are there no signs of improvement? "Only older physicians," so state the editors in the preface, "who with their own eyes have seen the desolate condition of cancer patients before the antiseptic era, can fully appreciate the marvelous advances of today over former times. Then, every one with cancer of an inner organ, no matter what treatment he received, was, without exception, left to a pitiable, often cruelly slow dissolution. Today there are many thousands every year who are cured from cancer of the inner organs for the rest of their lives, and their number is growing steadily."

This optimistic and courageous attitude and the outlooks it opens for surgical, radiological, and vaccine treatments, is immensely appealing. In fact, I find it difficult to speak of the work without using superlatives constantly. The make-up of the book vies with its contents. Paper, print, and illustrations are excellent, and the 44 large colored plates rank, I am sure, among the best I have ever seen.

THE Spanish translation of Liepmann's *Clinical Lectures on Obstetrics*[2] brings to mind the attractive features of the German original which were reviewed in these columns a few years ago. Our colleagues in Central and South America will undoubtedly profit by the fact that this work with its thoroughly modern and sound teaching has been made easily accessible to them.

THE same indefatigable author whose books cover a wide range of subjects, now presents to us an essay on criminal abortion.[3] There is, first, an estimate of the rapidly growing frequency of abortion which, in Germany, has at present reached the appalling number of 875,750 per year, and its frightful mortality. Then follows an exposition of the causes of danger in criminal abortion, a survey of the morbidity, and a more detailed description of the various traumatisms and the slim chances of recovery. In the closing chapter entitled "Retrospect and Outlook," the underlying deeper causes of the phenomenon in question are analyzed, the shortcomings of our own profession characterized, and possible remedies suggested. In short, the author paints the evil in all its grossness. And then, not satisfied with the impressive word picture, he adds an atlas of 24 large plates on which every conceivable sort of injury from the simple instrumental perforation of the uterus to the pulling out and tearing off of intestinal loops is extremely well depicted.

It is a meritorious undertaking that deserves to be known in the widest possible circles. But this is the unfortunate part that the book and the lessons it so convincingly teaches, will remain unknown to the very people who are most concerned in this question. For you and I who read the book, are fully in accord with the author; we know the manifold dangers of criminal abortion and disapprove of it from moral, ethical, sociological, in fact, from

[1] Die Klinik der boesartigen Geschwuelste. Edited by Geh. Rat Prof. Dr. P. Zweifel and Geh. Med.-Rat Prof. Dr. E. Payr vol. iii. Leipzig: S. Hirzel. 1927.

[2] Clínica Obstétrica. By Prof. Dr. Wilhelm Liepmann. 4th ed. Translated from the German by Dr. Victor Conill y Montobbio. Barcelona: Salvat, 1926.

[3] Die Abtreibung. Eine medizinisch-soziologische Studie in bildlichen Darstellungen fuer Aerzte, Juristen und Soziologen. By Prof. Dr. W. Liepmann. Berlin and Vienna: Urban & Schwarzenberg, 1927.

every possible standpoint. The abortionist of either sex, however, with or without the prefix of M.D., would not read a book of such a tenor; he would, indeed, not know of its existence. And those misguided girls and women who, in their dense ignorance, entrust life and limb to the nefarious manipulations of the abortionist, will they be reached by this book and pause to think?

The problem is world wide, and the anxiety of the author for the future of his fatherland is not greater than ours should be, though we may boast of our country as the land of unlimited possibilities and unlimited resources. A reform must come, but it can not come from without. It must come from within, that is to say, by way of education. Our puritanical hypocrisy that speaks of the red plague when it means syphilis, and terms illegal operation what is criminal abortion, may, for a while, stand in the way of progress. But not forever, not even for very long. The educational cancer campaign which, in this country, is directed by the American Society for the Control of Cancer, has shown, what only 15 years ago would have seemed impossible, that one may safely speak to the lay public on subjects which would have appeared indecent to Mid-Victorians and their daughters and granddaughters. The Social Hygiene movement is beginning to call a spade a spade in public meetings, and scorns the circumlocution of "damaged goods." Very soon, let us hope, such publicity will be given to criminal abortion; then the dark practice will openly be called by its real name and the abortionist exposed to bright daylight, and his victims will have to learn the facts and the truth, however unwilling they may be. And at that time, the book before us, with its startling statistics, its clear line of thought, and its instructive illustrations, will serve as a guiding text to those who will disseminate this much-needed knowledge.

EVERY new textbook of obstetrics is of benefit to the profession. As the bulk of obstetrical work is carried on by the general practitioner, the avenues of instruction in this, the most important and the most difficult of all special branches of medicine, can not be too numerous. To fulfill its purpose, such a textbook should contain only what it is important and necessary for the practitioner to know, and this has been the principle which guided Zangemeister in the writing of his work.[1] It may be stated, at the outset, that he has succeeded in his task. His descriptions are concise and to the point and, yet, omit nothing that is essential. In the preface, he claims for his book the advantages of homogeneity because he has written it without collaboration with others. The personal equation is, therefore, quite noticeable throughout the book and enlivens the study. In the chapter on eclampsia, face presentation, and several other subjects, the author's own contributions take their place. Among the pictures, many of which are in colors, there are numerous instructive original illustrations. The chapters on the puerperium and the newborn seem to me particularly attractive. The hints on diagnosis in labor are exceptionally good; they will sharpen the student's power of observation and do away with many an unnecessary internal examination. Prenatal care and the management of the normal puerperium impress me as being discussed a trifle too epigrammatically; more space could, perhaps, be gained for these subjects by curtailing the somewhat lengthy statistical offerings of which I believe, contrary to the author, that they are not very popular with the average reader.

AN interesting innovation in French obstetrical literature is the systematized bibliography[2] which Vignes and Dauphin have fashioned somewhat after our own Year Book and similar Reviews in this country and Germany. The more important contributions of the year 1924 are grouped under such headings as ectopic pregnancy, abortion, physiology and pathology of pregnancy and of labor, obstetrical therapy, legal and social obstetrics, history of obstetrics, etc. Preceding this part, Vignes presents a number of brief collective reviews of special subjects of particular interest, for instance, glycosuria in pregnancy, causes and nature of toxæmia, influence of diseases of the oral cavity on pregnancy; in these he does not confine himself strictly to the literary output of only the one year.

A large part of the papers enumerated in this volume is French, and in this lies its more specific interest and importance to us to whom French literature is not always easy of access. As a book travels across political frontiers, it builds bridges between the workers in obstetrics in various countries, makes for better mutual understanding, and removes obstacles in the path of progress of medical knowledge.

[1] LEHRBUCH DER GEBURTSHILFE. By Prof. Dr. Wilhelm Zangemeister. Leipzig: S. Hirzel, 1927.

[2] L'ANNÉE OBSTÉTRICALE (TRAVAUX DE 1924). By H. Vignes and J. Dauphin. Paris: Masson et Cie, 1926.

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